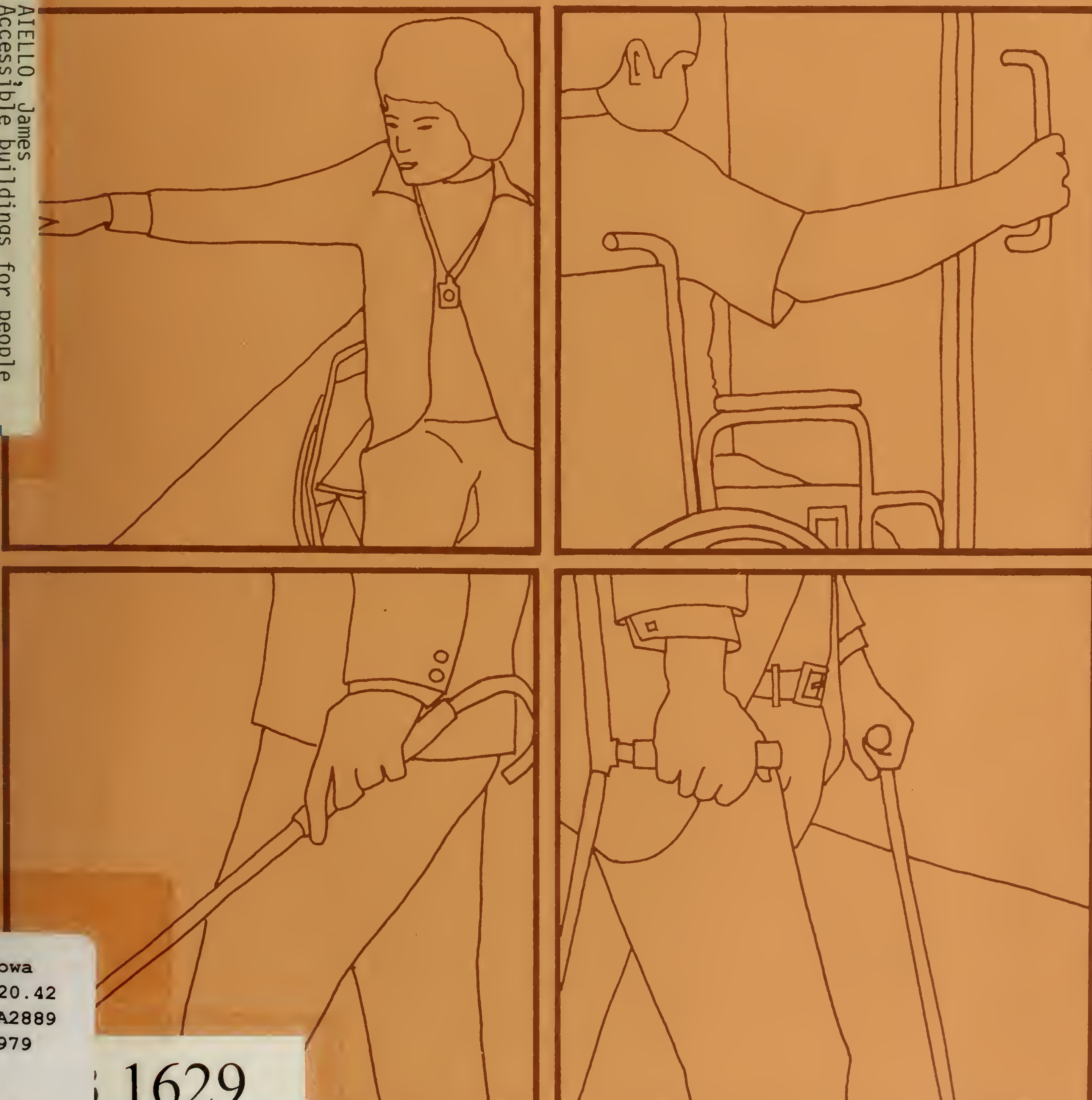
U.S. Department of Housing and Urban Development
Office of Policy Development and Research

# Accessible Buildings for People with Severe Visual Impairments



# Accessible Buildings for People with Severe Visual Impairments

**Prepared For:**

U.S. Department of Housing and Urban Development
Office of Policy Development and Research

**Under:**

Contract H-2200 to Syracuse University


**Project Director:**

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The research and studies forming the basis for this report were conducted by Syracuse University pursuant to a contract with the U.S. Department of Housing and Urban Development (HUD) Office of Policy Development and Research. The statements and conclusions contained herein are those of the contractor and do not necessarily reflect the views of the U.S. Government in general or HUD in particular. Neither the United States nor HUD makes any warranty, expressed or implied, or assumes responsibility for the accuracy or completeness of the information herein.

# FOREWORD

Over the last decades, Americans have been learning to see what we have never seen before. I refer not to flying saucers but to people -- people who have been hidden from us by prejudice, by custom, and by ignorance. Ralph Ellison described the phenomenon for blacks in his powerful novel, The Invisible Man.

Today, finally, we see the black population; we are only beginning to see other groups -- women, the American Indian, the elderly, the handicapped -- see them both as national resources and as groups having claims on the national conscience.

This publication is one of a series of six, the titles of which are listed in the acknowledgements, that HUD's Office of Policy Development and Research has sponsored to accomplish the important task of making buildings accessible to and usable by the physically handicapped through improving the American National Standards Institute's A117 standard.

Prepared under the supervision of the Office of Policy Development and Research, these volumes have won a research award from Progressive Architecture. To quote from the jury comments: "In terms of the effect that the work will have on future architecture and planning, the new ANSI standard A117.7 has got to be the blockbuster of all.....It's a very solid piece of work."

It is indeed. I am proud to present it to you.

Donna E. Shalala
Assistant Secretary
for Policy Development
and Research

Acknowledgements

We would like to acknowledge the following individuals for their assistance in this study. Dan McLaugnlin and Hannelare Ketterer, Orientation and Mobility Specialists at Lighthouse of Onondaga County and Bill Sherrow, for their expert advice and guidance in planning and carrying out the study. John Emperor, Counselor at the Syracuse Office of the Commission for the Visually Handicapped, for helping recruit participants. Jay Leistner for his invaluable assistance during the last two phases of the study. Eunice Fiorito, Director of the Mayor's Office for the Handicapped in New York City. Steven Schroeder and Rolf Faste for their input at the design workshop following the completion of the first phase. Jean Caraccilo for typing and William Lange, Jonathan Perlstein and Laurence Mufson for several of the illustrations. And, most importantly, all of our consumer testers.

This report is one of a series of reports prepared under this contract. The full series includes:

1. Access to the Built Environment: A Review of Literature
2. Accessible Buildings for People with Walking and Reaching Limitations
3. Accessible Buildings for People with Severe Visual Impairments
4. The Estimated Cost of Accessible Buildings
5. A Cost-Benefit Analysis of Accessibility
6. Adaptable Dwellings

All of this research contributed to the development of the proposed revisions to ANSI A117.1, Making Buildings and Facilities Accessible to and Usable by the Physically Handicapped.

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Abstract

This study was conducted as part of a larger project carried out by the School of Architecture, Research Office at Syracuse University, and was sponsored by the U.S. Department of Housing and Urban Development. The purpose of the project was to revise and augment the ANSI (American National Standards Institute) Standard, A117.1 (1961, R 1971), Specifications for Making Buildings and Facilities Accessible to, and Usable by, The Physically Handicapped.

The objective of this portion of the project was to determine whether the usability of buildings for people with severe visual impairments could be enhanced through design. Since no empirical research has been documented previously on mobility of blind and partially sighted individuals in buildings, this research included problem identification as well as a search for recommended problem solutions.

A combination of field research, expert brainstorming and laboratory testing was used in the study. There were three research phases. Conclusions drawn from this research led to the formulation of several recommendations for design criteria.

The report is presented in eight parts. The first two sections deal with background and offer a summary description of the study and the methods. In Sections Three, Five and Six, the three phases of testing are covered, with discussions of the research methods and presentation of data. Section Four deals with the design workshop held after Phase 1, and conclusions, design recommendations and suggestions for further research are presented in Sections Seven and Eight.

# 1

# Introduction


EDWIN A. LINK
HALL OF ENGINEERI

## Introduction

### How many people are visually impaired?

According to a 1972 estimate published by the American Foundation for the Blind, approximately 6.4 million persons have some kind of visual impairment--that is, some trouble seeing, even with corrective lenses (American Foundation for the Blind, Inc., 1975, p 5, Note 1). Of these about 1.7 million have severe impairments (Murphy, 1975, p 2). This means that they are either legally blind (see Glossary) or function as if they were, even though their vision is such that they cannot be classified as legally blind. Approximately 450,000 persons are considered to be legally blind (Murphy, 1975, p 2).

About four percent of those with severe visual impairments are under 25 and eight percent are between 25 and 44. Data also show that about 65 percent of those with severe visual impairments are over 65 years of age (22 percent between 65 and 74; 43 percent over 75). The incidence of blindness increases with age, which carries with it a higher rate of blindness due to age-related illnesses (Murphy, 1975, p 2). The percentage of blind individuals in the over 65 category can be expected to increase, therefore, as our life expectancy gets longer and our elderly population increases.

Only about 20,000 persons, or 1.2 percent of those with severe visual impairments are in the labor force. Approximately three percent of those with severe impairments are of pre-school age: 1/3 are too young to be in a learning institution, while 2/3 attend a school (this includes an estimated 3,000 college students) (American Foundation for the Blind, Inc., 1975, p 6).

### The Mobility of the Visually Impaired

The majority of those persons with severe visual impairments achieve some level of independence in traveling. How high a level depends on a number of physical, psychological or social factors which are unique to each individual. Some of the more important variables affecting mobility are: the cause, nature and extent of visual impairment; whether the impairment is congenital or adventitious; whether there are other disabilities or not; the person's age, health, life experience and level of concept development; how highly the person is motivated to move out of their home; immediate or long range goals; the amount of encouragement, support and acceptance received from the family, friends and the general public; the quality of the rehabilitation experience; whether or not orientation and mobility training was taken and to what extent; and last, but not least, the quality of the environment in which the individual functions (i.e. to what degree is it a barrier-free environment).

### Previous Research

Previous empirical research regarding orientation and mobility of visually impaired individuals can be categorized into four general areas. First,

there is research on theory, techniques and training, exemplified by the work conducted by J. Alfred Leonard and the University of Nottingham Blind Mobility Research Unit (Leonard, 1972). Studies in this area deal primarily with assessments of the state of the art, analyses of orientation and mobility concepts, and modification of old concepts or the development of new ones to improve instruction and raise the level of blind mobility.

Next is the research designed to develop auditory or tactual aids to improve orientation and mobility. Auditory maps or verbal description of environments have been investigated by Blasch, Walsh and Davidson (1973), and Leonard and Newman (1970); Kidwell and Greer (1972 and 1973) did extensive research and developed a tactual map of the Massachusetts Institute of Technology campus in Boston; and James and Swain (1975) produced a tactile map of Nottingham City Centre in England to aid the blind in learning bus routes.

In addition, Leonard and Newman (1970) conducted a study comparing results obtained from the use of three types of mobility aids: the audio map, the tactual map and the disk.[2] In all of the above studies, it was found that with extensive training, auditory and tactual aids could improve orientation and mobility, but that further research in this field was necessary to refine the aids so that they could be used with a minimum amount of training.

A third general group of studies deals primarily with the research and development of sensory aids for the blind, such as the laser cane, sonic glasses and other mechanical devices (Leonard and Newman, 1970 and Kay, 1974).

The final category of research regarding orientation and mobility of the visually impaired is that aimed at improving environmental design to enhance usability. Nugent (1960) included a variety of design criteria in the ANSI A117.1 (1961, R 1971) Standard that he developed; Braf (1974) produced a monograph illustrating the types of environmental problems the visually impaired traveler encounters; and McGlinchey and Mitala (1975) proposed a plan to modify a hospital ward in an institution serving blind individuals.

## The Focus of the Present Study

Undoubtedly, the area that has seen the smallest amount of empirical research has been environmental design to enhance usability by visually impaired travelers. Therefore, when the Architectural Research Office at Syracuse University was charged with proposing revisions to the ANSI A117.1 Standard in 1974, an extensive investigation into architectural barriers to blind people was planned.

The focus of this study was to: 1) investigate the types of orientation and mobility problems visually impaired individuals have in architectural settings and 2) propose and test design solutions to help alleviate these problems. It is hoped that the design recommendations based on the results and conclusions of this research will be incorporated into the revised ANSI A117.1 Standard.

# 2

# Methods

## Summary of Methods

### Recruiting

The participants for the research were selected from a roster of present and former clients of orientation and mobility specialists at The Lighthouse of Onondaga County and the Syracuse Office of the Commission for the Visually Handicapped. The Lighthouse or Commission contacted each person first to ascertain interest in the project. Individuals were chosen on the basis of two criteria: 1) each was adjudged mentally and emotionally able to participate and 2) each had shown independence in mobility, at least in their home environment. We also attempted to construct a group containing persons with a wide range of sight disabilities.

### Phase 1

Twenty-eight individuals participated in the first phase of the study. Each person first completed a background interview. This interview assessed attitudes of risk taking and self-esteem and identified specific disability.

Next, using recorded directions, they walked a route in a building on the Syracuse University campus. The route was chosen because it presents many types of orientation cues. As they walked the route, each was timed and observed using a standardized checklist to note difficulties.

After the walk, each person was debriefed. In this session they made a map of the route, and a post-walk questionnaire was completed. This session was designed to ascertain cognition of the route, identify orientation and mobility problems and identify methods used to negotiate the route.

### Design Workshop

Following the completion of the field research, the data were analyzed to identify the major difficulties with the route and the features that aided mobility. A design workshop was held to ascertain the areas requiring further research and to brainstorm possible solutions to mobility problems.

Discussions revolved around three design issues identified after reviewing the Phase 1 results and that were felt to be within the realm of design standards: 1) warnings of imminent danger, 2) doors in public buildings and 3) standardized direction finding cues. In addition, the target population, for whom the design standards were being developed, was discussed.

Other issues raised, but not specifically covered during the workshop, were the elimination of confusing, irregularly shaped areas in public buildings and the reduction of unnecessary level changes.

## Phase 2

A subgroup of eight individuals from Phase 1 participated in Phase 2. Each was selected because he or she used the long cane as a mobility aid, was considered an average traveler (based on performance in Phase 1) and professed an interest to continue on the project.[3]

Following the Phase 1 workshop, it was concluded that one of the major areas requiring further investigation dealt with warnings of imminent danger--the danger being staircases, drop offs and extreme level changes. For Phase 2, therefore, a laboratory experiment was constructed to test average pace, stopping distance and tactile floor cue recognition.

During the recognition procedures, participants tested a number of tactile floor signals. The important factors that were investigated were: 1) height of raise of the signal, 2) the size of the signal, 3) the pattern of the material on the surface and 4) the resiliency of the material. Participants were observed and questioned to determine which signals were easily detected.

## Phase 3

Signals that work in a laboratory setting may not work as well in actual installations. Thus, a route in another campus building was chosen for the final phase of testing. The newer route presented fewer problems than the first route, and it was hypothesized that it gave clearer orientation and mobility cues. Thus, confusion in the route would not interfere with warning signal recognition.

Tactile floor warnings were installed at the tops of all staircases and in front of the elevator. In addition, an experiment was designed to test the use of raised numerals on an elevator control panel. Five participants were tested in Phase 3, all of whom participated in Phase 2.

Participants proceeded through the route and were observed to note their detection of and reliance on the tactile warnings. Afterwards, a debriefing interview and mapping exercise were completed as in Phase 1. In addition, each person completed a protocol in which their impressions and comments were solicited and recorded as they walked through the route a second time. This helped determine each person's "image" of the route.

# 3

# Phase 1


HALITE
HALITE
HALITE
HALITE

## Detailed Methods and Findings - Phase 1

### Subjects

Twenty-eight blind individuals participated in Phase 1. The average age of the research group was 42 years; the oldest was 85 and the youngest was 20. Thirteen individuals were congenitally blind (five totally and eight partially), and 15 were adventitiously blind (seven totally and eight partially). The 16 participants who were partially sighted have some degree of either light, color or object perception, or a combination of the three.

All but one of the consumer testers had some formal mobility training. The group included both rote and independent travelers. Nineteen used a long cane as their mobility aid and five used a dog guide. Four traveled visually.

Each person completed a background questionnaire, walked a route in the basement of Slocum and Link Halls on the Syracuse University campus and participated in a debriefing session.

### Background Questionnaire

The background questionnaire was designed to gather three categories of data on each participant: 1) demographic information, 2) history of blindness and orientation and mobility training and 3) attitudes. The questions were based partly on responses given by ten orientation and mobility specialists who were asked to indicate those variables which they thought most influenced visually impaired individuals' orientation and mobility. A discussion of the construction of the questionnaire and an analysis of some of the results are presented in Appendix A.

### Experimental Setting

The Slocum-Link basement route (see Fig. 1) was chosen because it presents many types of problems to the blind user and also many types of orientation cues. The route includes these environmental features: 1) maze-like corridors, 2) large, undefined open spaces, 3) obstacles of many kinds (permanent and mobile), 4) several different acoustical cues and properties, 5) olfactory and thermal cues, 6) changes in floor textures and other tactile cues, 7) various types of doorways and openings, 8) a ramp and a staircase, 9) crowded and uncrowded areas and 10) several types of intersections.

The route was divided into five segments and the participants were played a set of recorded directions before beginning each segment to help them negotiate the walk.[4] Aid was given only when it was solicited or if a danger to a person was perceived by the observer. Fig. 2 shows the various segments of the route, the directions used to help participants negotiate each segment and graphically indicates the landmarks, information points and obstacles present along each segment.

## Walking the Route

As the participants proceeded through the route, they were timed and observed using a standardized checklist to note directional and environmental problems. The observer's checklist package consisted of a tally sheet and maps of each segment upon which all problems were noted. There were three categories for direction problems:

1. D.0 - directions not used,
2. D.1 - problem with direction on participant's part; e.g. forgot directions or mistook left for right--aid necessary to reset on course,
3. D.2 - direction inadequate or confusing--aid necessary to reset on course.

There were also three categories for environmental problems:

1. E.0 - obstacle not negotiated, segment terminated and not restarted,
2. E.1 - obstacle negotiated, but with difficulty; obstacle negotiated with or without aid; walk may be temporarily halted so that participant might be reset on course,
3. E.2 - obstacle encountered, but negotiated with ease and without aid.

## Mapping Exercise

Immediately following the completion of the walk, each person was asked to produce a map of the route. This exercise was devised to ascertain their cognition of the route. This was important because we had hypothesized that areas that were distorted on the maps would correspond to areas along the route which the testers had difficulty negotiating.

We also hypothesized that the map distortions would help identify areas along the route which had poor imageability; that is, the cues or landmarks which a person used to identify a place were not easily identifiable. Therefore, one's image of that place would be distorted and mobility problems would arise.

The participants were offered three options as to how to construct their map: 1) they could give a verbal description, 2) they could draw the map on a large piece of white paper with a marker or 3) they could construct a tactile map using magnetized rubber strips and a magnetic board. In order to record the tactile maps, a piece of tracing paper was layed over the map and a tracing was made of it.

## Post-Walk Questionnaire

The final task that each participant was requested to complete was the post-walk questionnaire. This instrument was designed to: 1) identify problems each person encountered during the walk, 2) identify methods

used to negotiate the route and 3) ascertain the participant's cognition of the route. (See Appendix B for a copy of the questionnaire.)

In addition, each participant was asked to discuss problems that they encountered in their day-to-day travels, and to air specific problems about the way buildings are designed. It should be noted that all throughout the session, participants were encouraged to offer solutions for the problems that they encountered, both during the walk and in their day-to-day travels.

## Results of Field Research

The average time needed to complete the route was seven minutes (minimum--4:14, maximum--14:20). The average number of environmental problems was eight or nine (minimum--0; maximum--23), and the average number of directional problems was two or three (minimum--0; maximum--6). All but one of the participants judged the course easy to negotiate. Figures showing a complete listing of all directional and environmental problem points are presented in Appendix C.

Results and analysis are presented here by route segment. The identification of problem areas along the route is based on the analysis of 1) data gathered during the walk, 2) the maps of the route (a discussion of some of the maps is presented in Appendix D) and 3) data gathered from the post-walk questionnaire. Note that in this portion of the report, the data reflects sessions with only 26 of our 28 consumer testers, since two of our participants could not complete the mapping exercise.

Segments 1 and 5 (the foyer and the passageway):

Cnly three consumer testers negotiated these segments without any problem. The foyer area was large and confusing, noisy and distracting. Straight line travel was difficult, expecially when the area was crowded. It was also difficult to pick up sound cues to aid orientation and mobility. The area was cluttered with obstacles, both mobile and permanent. Some, like overhanging display cases, are extremely dangerous obstacles. Others, such as the display cases and the pillars, were the same color as the walls and blended in making it difficult for the partially sighted person to see them. The passageway connecting Slocum and Link Halls was difficult to find. The technique of trailing was difficult to use because of the obstacles along the wall. The directions in segment 1a, guiding the subjects to the passageway, and the directions in segment 5b, guiding clients through the foyer area and back to their starting point were not helpful. Since our travelers could not successfully trail the wall to find the "fourth doorway on (their)... right" (1a), the absence of alternative cues made it very hard to find the passageway. Also, by not describing the lobby and it relationship to the passageway and the starting-ending point (5b), participants became confused or lost.

The passageway was irregularly shaped--sometimes wide, sometimes narrow, and travel was hindered by a number of obstacles that were along the

walls on both sides. Cracks in the cement, a grating on the floor and a small rise/drop in the floor level just before the door between the two buildings also hindered travel. The loud, constant machine noises distracted and confused people, making it difficult to concentrate, and hard to hear audio cues. The door posed a variety of problems: the knob was hard to find, participants were unsure as to which way the door opened and persons passing through the door from the opposite direction startled and confused them. Only five persons mapped this segment of the route correctly: that is, had the direction of travel and turns right, equated segment 1 with segment 5 and began and ended the map at the same point. Major mapping difficulties centered around the passageway (segments 1b and 5a), where problems caused by obstacles, directions and changing noise levels affected imageability.

Segment 2 (ramp and machine shop areas):

This segment was the second easiest section of the route to negotiate as there were a minimal number of obstacles present. However, half (13) of the participants experienced difficulty in this section. The major difficulties were the irregularly shaped areas at each end of the downward sloping ramp. Participants became disoriented, especially in the area just inside the door separating the two buildings. In addition, the directions guiding the subjects to the ramp from the door were not as much help as they could have been. A potentially dangerous situation existed if blind travelers were allowed to travel straight ahead away from the door toward the staircase, since there was no warning of its pending approach. Finally, the recessed door to the machine shop near the end of the segment appeared to be a corridor. The positive aspects of this segment were the changes in surface texture on the ramp, the quiet of the area after the din of the passageway, the minimal number of obstacles present and the relative simplicity regarding line of travel. These features tended to enhance the image of this segment. Thus, only five persons mapped the area incorrectly, the main difficulty being the large areas at the top and bottom of the ramp.

Segment 3 (the jog):

This segment was the second most difficult one to negotiate. In addition, the image of this segment was very weak and only five people mapped it correctly. The primary problem affecting travel and imageability was the hallway jog, located in the middle of the segment. Travelers became disoriented, and problems encountered here had an effect on whether or not the traveler found the correct corridor to turn into. Generally, the more confused the traveler became in the jog, the less likely it was that he or she would complete the segment unaided or map it correctly. The directions were also not very helpful in guiding the participants through this area. Travel through this area and its imageability would have been enhanced by the acoustics and obstacle-free nature of the corridor, had it not been for the hallway jog.

Segment 4 (the staircase):

Only two persons had problems in this segment and 23 mapped it correctly. There were a minimal number of obstacles present, the area offered good acoustics and the line of travel was straight. No one had problems negotiating the staircase, although most were usually startled when they encountered it. The only portion of segment 4 that caused problems was the large, irregularly shaped area after the stairway and before the door to the passageway.

## Summary of Findings

In general, there were three types of mobility problems encountered in the Slocum-Link route:

1. traveler disorientation, indecision and confusion because of area configuration
   a. large, undefined areas
   b. irregular route paths
2. hazardous and difficult to negotiate situations caused by intervening obstacles
   a. overhanging objects
   b. irregularly spaced objects lining the walls
   c. a "jagged edge of travel", with some objects protruding into the path more than others
   d. irregular sound patterns which masked or distorted sound cues necessary for easy travel
3. problems caused by poor directions, such as indecision, disorientation and confusion.

The positive aspects of the route were present primarily in Link Hall, which is the newer of the two buildings. Here the relatively straight paths of travel and conditions which presented useful sound and thermal cues aided travel.

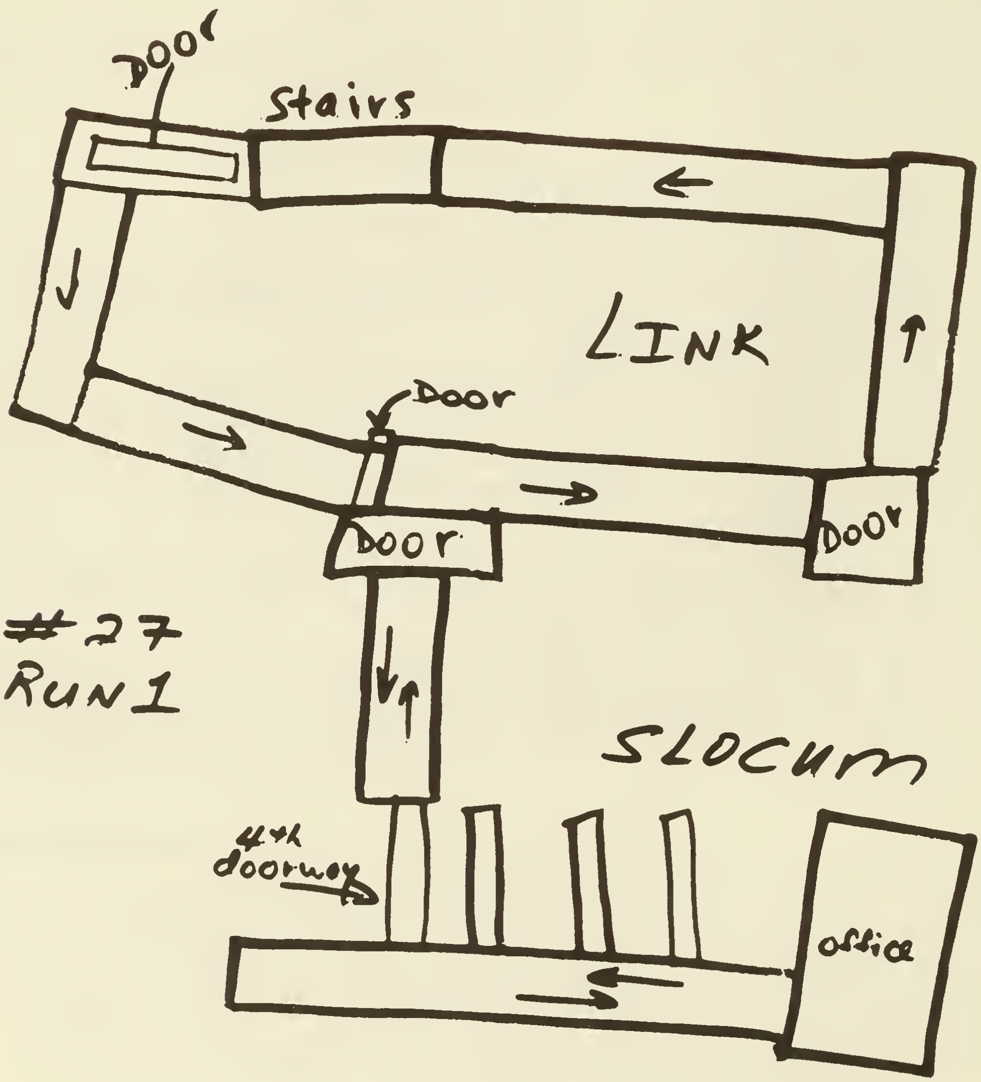
Regarding the correlation between map distortions and orientation and mobility problems, the results showed that:

1. segment 4 was the most imageable as well as the easiest to negotiate,
2. segment 2 was the second most imageable as well as the second easiest to negotiate, and
3. segments 3, 1 and 5 were the least imageable as well as the most difficult to negotiate.

There is, therefore, a correlation between route imageability and ease or difficulty of travel, and the maps helped identify those areas along the route with decreased imageability, and where travel was more difficult.

Finally, there appear to be four variables which combined to affect the

participants' cognition of the route. First, disabilities affected cue selectivity and awareness so that they could not perceive the reliable cues that were available. Second, there were obstacles and noise which distracted attention or masked the other cues. Third, there were miscues that misled people, as do visual illusions. Finally, there was a lack of cues, or they were too weak in stimulus value to be perceived.



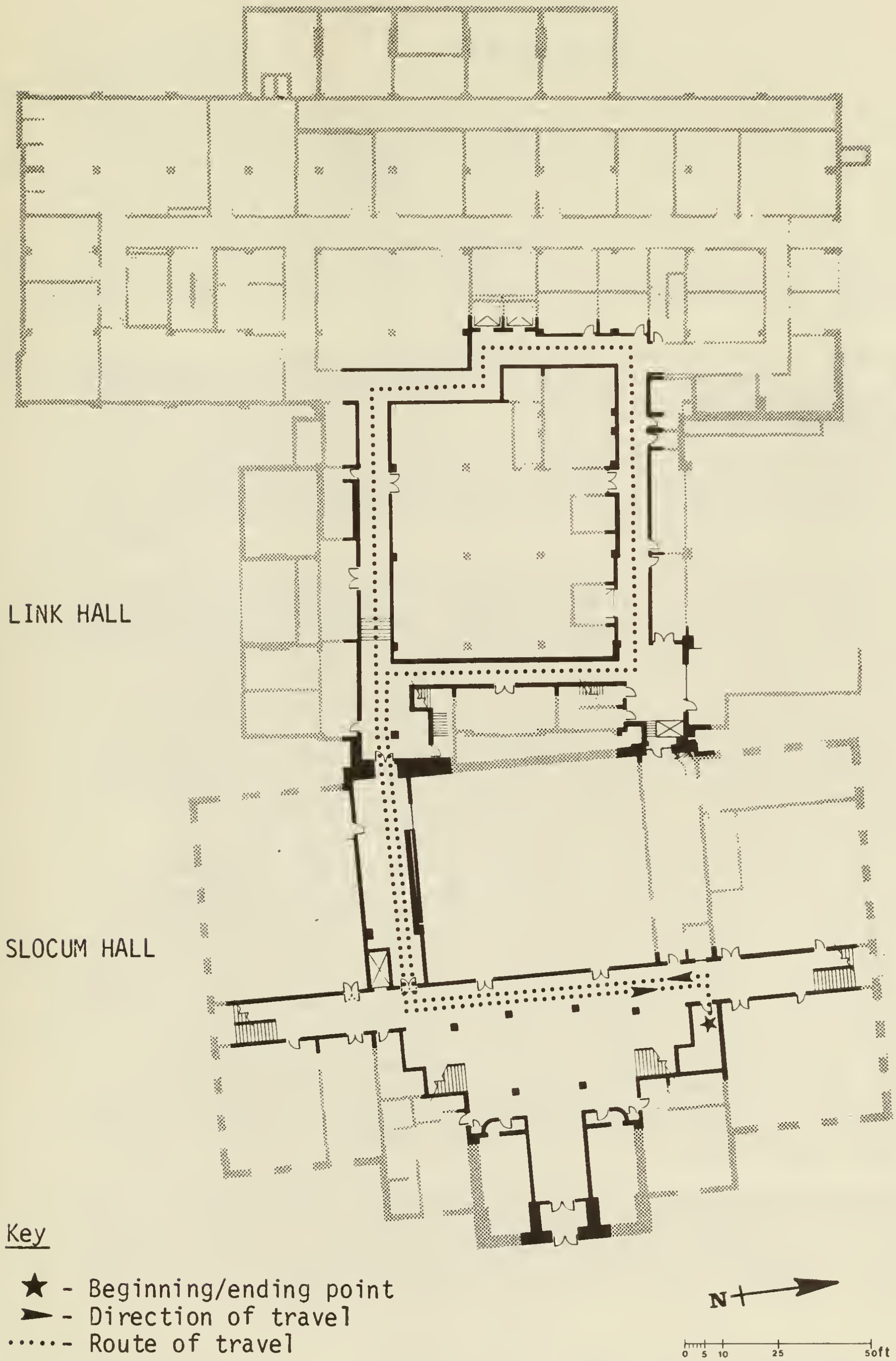



Figure 1: The Slocum-Link Basement Route

## ROUTE DIRECTIONS

The route that you are about to follow will take you from this room in Slocum Hall to a point in Link Hall and back again. The route has been divided into five segments. At the end of each segment you will have to stop and turn on the recorder to get directions for the next part of the walk.

The directions for each segment will be repeated twice. At the end of each set of directions you will hear a series of beeps. This is your signal to turn off the recorder and repeat the directions you have just heard back to me. Begin walking the segment only after you are sure that you completely understand the directions.

At this time I would like you to pause and outline the prodedure you must follow to me. Also, please feel free to ask any questions regarding the procedure so that we can clear up any problems before we start the walk. Okay, please turn off the recorder. (BEEPS)

Let me reiterate that the building is being tested and not your abilities, so there is no need to be overly concerned or upset when you have a problem. Also, remember that I will be nearby to aid you if you should have any major problems. Okay? Let's begin.

Here are the directions for segment number one. From your starting point you must go out of the room, into the hallway and turn left. Then go straight, and turn right through the fourth doorway on your right. After you turn right you will be in a hallway. Follow this hallway until you reach a door. Go through the door and stop. (I repeat.) Please turn off the recorder. (BEEPS)

Here are the directions for segment number two. From this point you must go straight about six paces and turn right into a hallway. Follow this hallway to an intersection and turn left into another hallway. Follow this hallway to the end, turn left and stop. (I repeat.) You will then be at your destination in Link Hall and you will have to turn on the recorder to receive directions for the next segment of the walk. Please turn off the recorder. (BEEPS)

You are now at your destination in Link Hall and are about to begin your return trip. Here are the directions for segment number three. From this point you must go along the hallway until you reach an intersection. At the intersection turn left, walk straight ahead until you reach a narrow metal strip on the floor that stretches from wall to wall and stop. (For those traveling with dog the previous sentence reads: At the intersection turn left, walk straight ahead about ten paces and stop.) (I repeat.) You must then turn on the recorder to receive directions for the next segment of the walk. Please turn off the recorder. (BEEPS)

Here are the directions for segment number four. From this point you must go straight down the hallway, up some stairs and continue down the hallway until you reach a door. Go through this door and stop. (I repeat.) You must then turn on the recorder to receive directions for the next segment of the walk. Please turn off the recorder. (BEEPS)

Here are the directions for the fifth and final segment. From this point you must go straight down the hallway to an intersection and turn left. Then go straight, cross the foyer and make a right turn through the door that is opposite the coke machine. (I repeat.) You will then be back in the room where you began and the walk will be finished. Please turn off the recorder. (BEEPS)

Figure 2: The Slocum-Link Route - by Segment

Key to Figure 2

Map A:

- 5b - Beginning of segment or sub-segment
- ⯅ - Direction of travel
- ····· - Route of travel
- ● - End of segment or sub-segment

Map B:

| Landmarks | | Information Points |
|---|---|---|
| **A** | Auditory | **a** |
| **O** | Olfactory | **o** |
| **T** | Tactual | **t** |
| **TH** | Thermal | **th** |

[Notations in parentheses (**a**) indicate that the landmark or information point is a property of the entire area.]

Obstacles

- *b* - Bench or chair (movable)
- *bd* - Bench (movable) with overhanging display case
- *c* - Column
- *e* - Electric circuit box
- *j* - Janitor's closet (added room)
- *i* - Irregular floor surface level
- *m* - Machine
- *p* - Vertical pipe (exposed)
- *s* - Storage area or closet (added)
- *t* - Telephone booth
- *v* - Vending machine
- *w* - Waste container

Notes

1. All doorways can be obstacles or auditory information points.
2. All occupied offices can be auditory information points.
3. All walls protruding into the path of travel or which are recessed can be obstacles or tactile landmarks.
4. Changes in air currents and/or temperature at intersections are thermal landmarks.
5. All obstacles and information points can be considered as landmarks if the route is traversed often enough.

Figure 2: (cont.)

Here are the directions for segment number one. From your starting point you must go out of the room, into the hallway and turn left. Then go straight, and turn right through the fourth doorway on your right. After you turn right you will be in a hallway. Follow this hallway until you reach a door. Go through the door and stop. (I repeat.) Please turn off the recorder. (BEEPS)

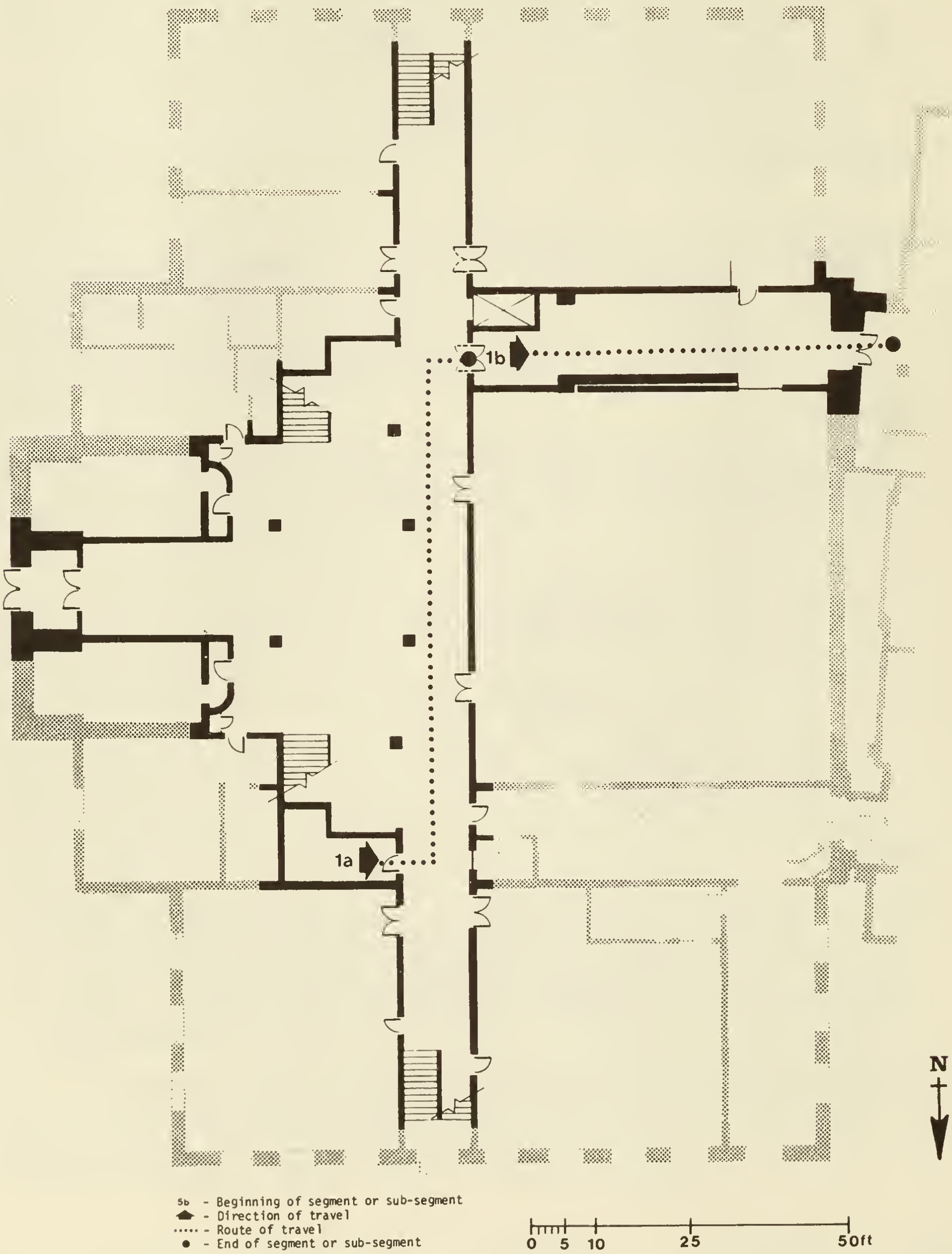
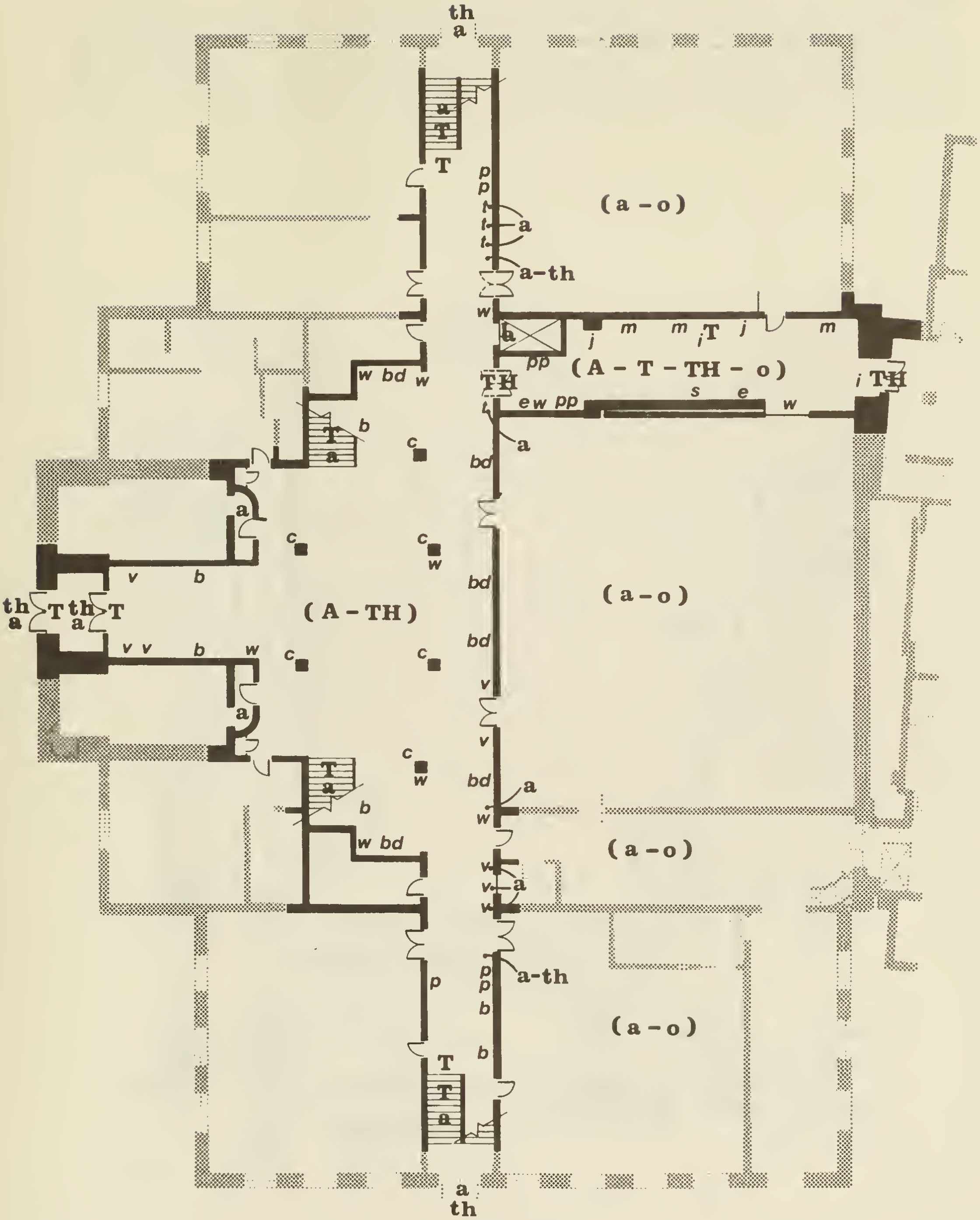



Figure 2.1.A: Segment 1




| Landmarks | | Information Points |
|---|---|---|
| A | Auditory | a |
| O | Olfactory | o |
| T | Tactual | t |
| TH | Thermal | th |

Obstacles

- b - Bench or chair (movable)
- bd - Bench (movable) with overhanging display case
- c - Column
- e - Electric circuit box
- j - Janitor's closet (added room)
- i - Irregular floor surface level
- m - Machine
- p - Vertical pipe (exposed)
- s - Storage area or closet (added)
- t - Telephone booth
- v - Vending machine
- w - Waste container

Figure 2.1.B: Segment 1 - Landmarks, Information Points and Obstacles

Here are the directions for segment number two. From this point you must go straight about six paces and turn right into a hallway. Follow this hallway to an intersection and turn left into another hallway. Follow this hallway to the end, turn left and stop. (I repeat.) You will then be at your destination in Link Hall and you will have to turn on the recorder to receive directions for the next segment of the walk. Please turn off the recorder. (BEEPS)

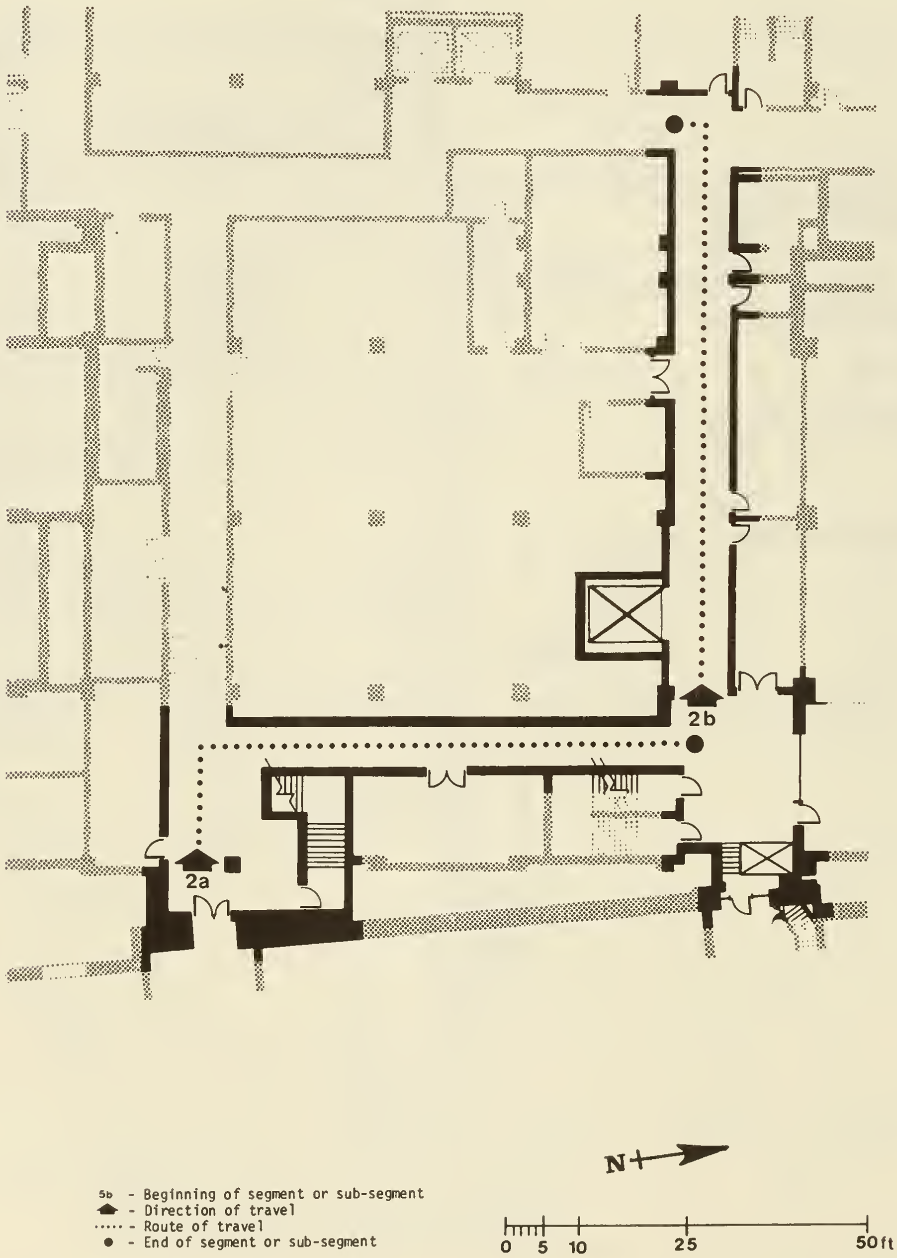
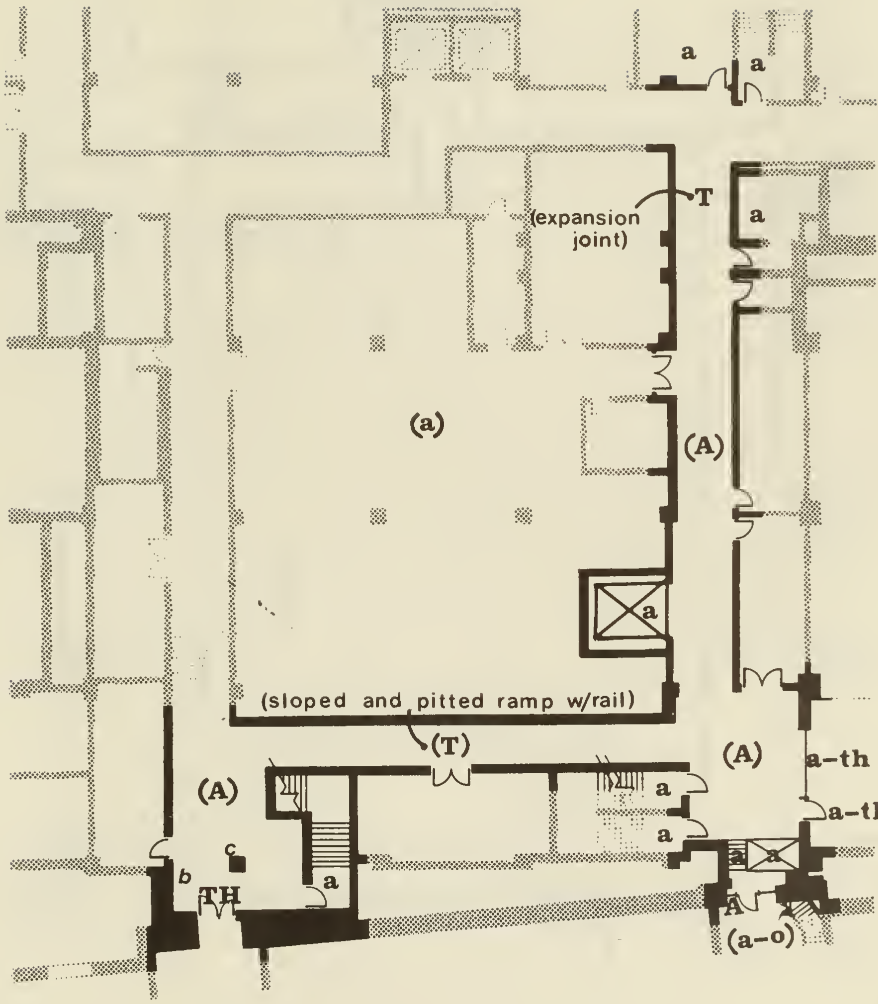



Figure 2.2.A: Segment 2




| Landmarks | | Information Points |
|---|---|---|
| **A** | Auditory | a |
| **O** | Olfactory | o |
| **T** | Tactual | t |
| **TH** | Thermal | th |

Obstacles

*b* - Bench or chair (movable)
*bd* - Bench (movable) with overhanging display case
*c* - Column
*e* - Electric circuit box
*j* - Janitor's closet (added room)
*i* - Irregular floor surface level
*m* - Machine
*p* - Vertical pipe (exposed)
*s* - Storage area or closet (added)
*t* - Telephone booth
*v* - Vending machine
*w* - Waste container

Figure 2.2.B: Segment 2 - Landmarks, Information Points and Obstacles

You are now at your destination in Link Hall and are about to begin your return trip. Here are the directions for segment number three. From this point you must go along the hallway until you reach an intersection. At the intersection turn left, walk straight ahead until you reach a narrow metal strip on the floor that stretches from wall to wall and stop. (For those traveling with dog the previous sentence reads: At the intersection turn left, walk straight ahead about ten paces and stop.) (I repeat.) You must then turn on the recorder to receive directions for the next segment of the walk. Please turn off the recorder. (BEEPS)

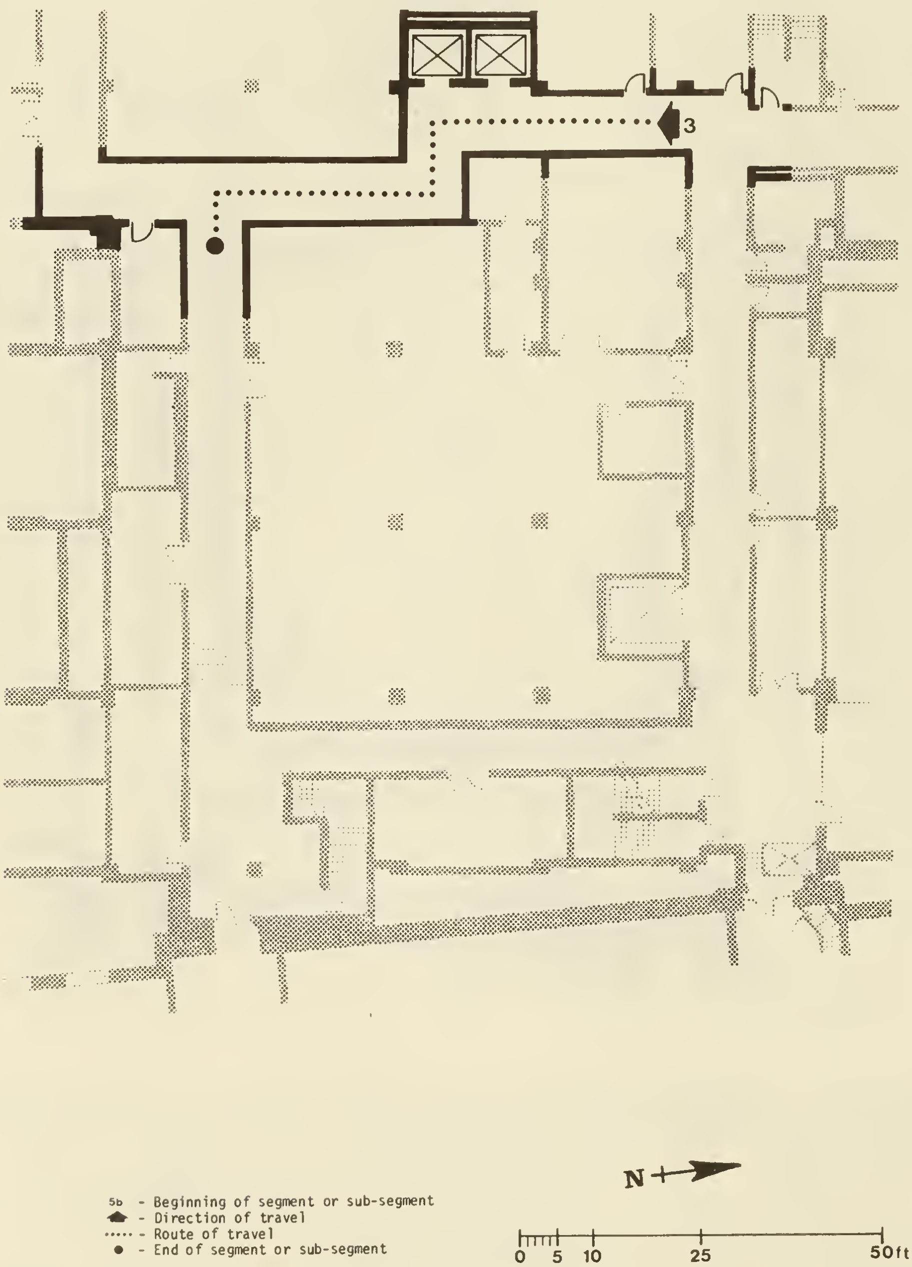
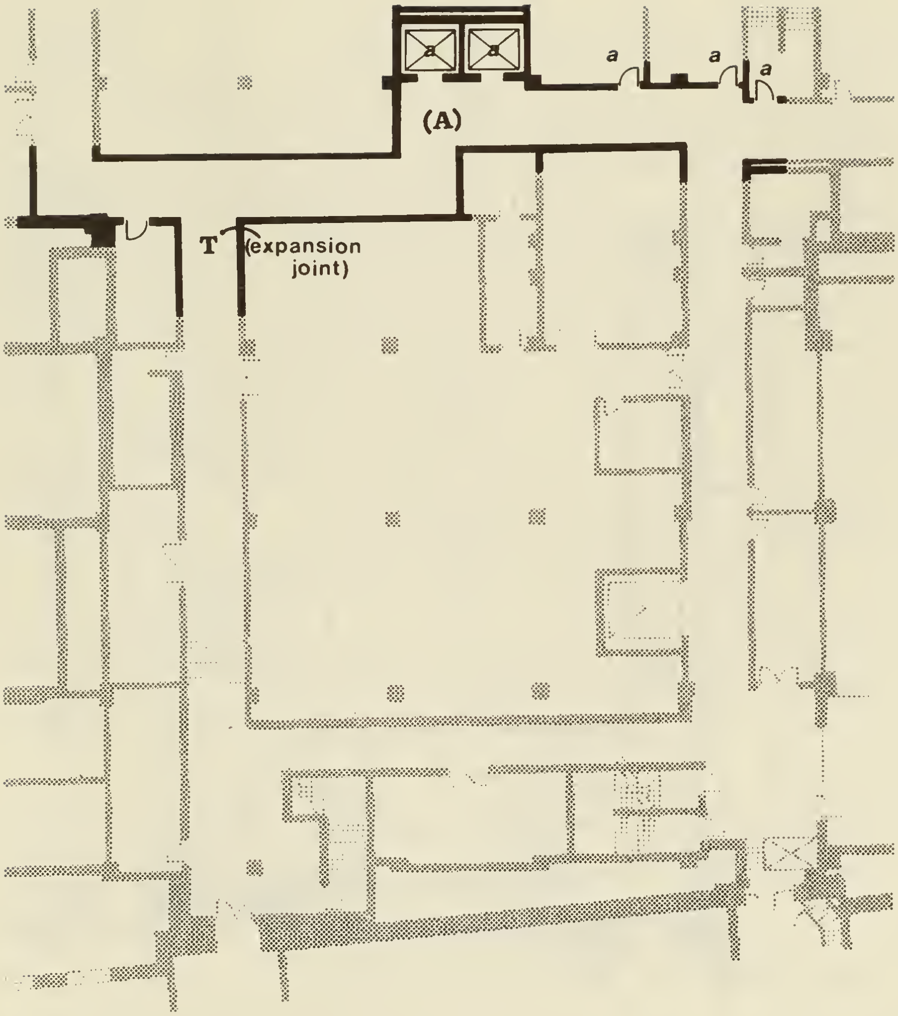



Figure 2.3.A: Segment 3




| Landmarks | | Information Points |
|---|---|---|
| A | Auditory | a |
| O | Olfactory | o |
| T | Tactual | t |
| TH | Thermal | th |

Obstacles

| | |
|---|---|
| b - Bench or chair (movable) | m - Machine |
| bd - Bench (movable) with overhanging display case | p - Vertical pipe (exposed) |
| c - Column | s - Storage area or closet (added) |
| e - Electric circuit box | t - Telephone booth |
| j - Janitor's closet (added room) | v - Vending machine |
| i - Irregular floor surface level | w - Waste container |

Figure 2.3.B: Segment 3 - Landmarks, Information Points and Obstacles

Here are the directions for segment number four. From this point you must go straight down the hallway, up some stairs and continue down the hallway until you reach a door. Go through this door and stop. (I repeat.) You must then turn on the recorder to receive directions for the next segment of the walk. Please turn off the recorder. (BEEPS)

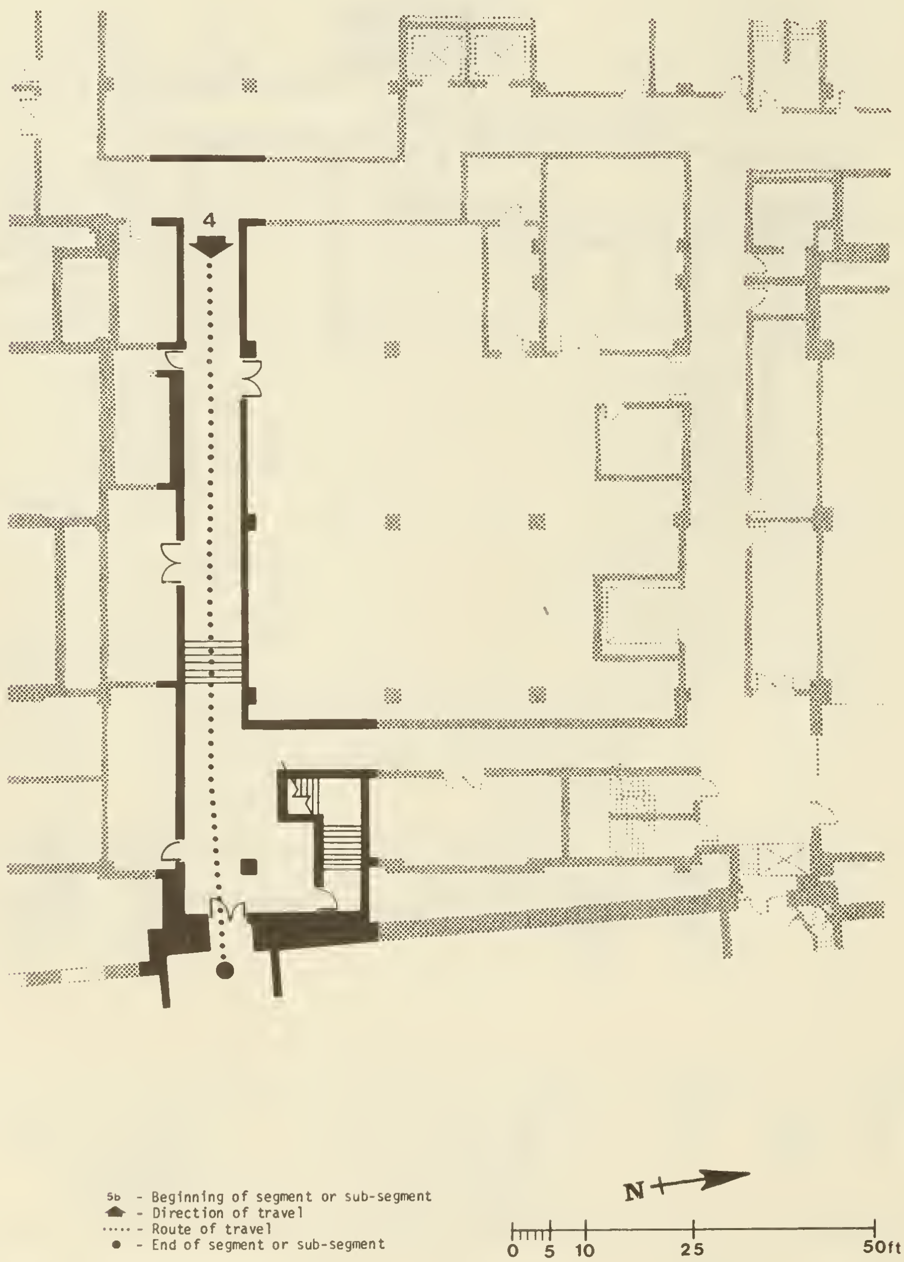
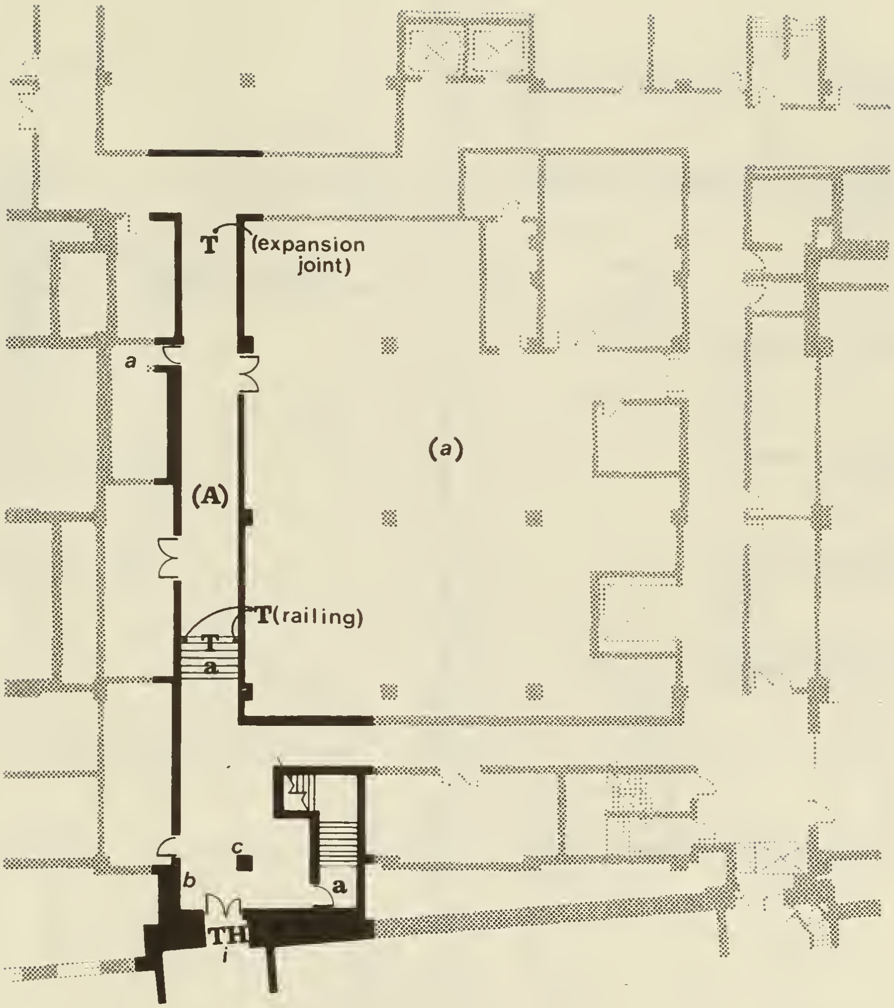



Figure 2.4.A: Segment 4




| Landmarks | | Information Points |
|---|---|---|
| A | Auditory | a |
| O | Olfactory | o |
| T | Tactual | t |
| TH | Thermal | th |

| Obstacles | |
|---|---|
| *b* | - Bench or chair (movable) |
| *bd* | - Bench (movable) with overhanging display case |
| *c* | - Column |
| *e* | - Electric circuit box |
| *j* | - Janitor's closet (added room) |
| *i* | - Irregular floor surface level |
| *m* | - Machine |
| *p* | - Vertical pipe (exposed) |
| *s* | - Storage area or closet (added) |
| *t* | - Telephone booth |
| *v* | - Vending machine |
| *w* | - Waste container |

Figure 2.4.B: Segment 4 - Landmarks, Information Points and Obstacles

Here are the directions for the fifth and final segment. From this point you must go straight down the hallway to an intersection and turn left. Then go straight, cross the foyer and make a right turn through the door that is opposite the coke machine. (I repeat.) You will then be back in the room where you began and the walk will be finished. Please turn off the recorder. (BEEPS)

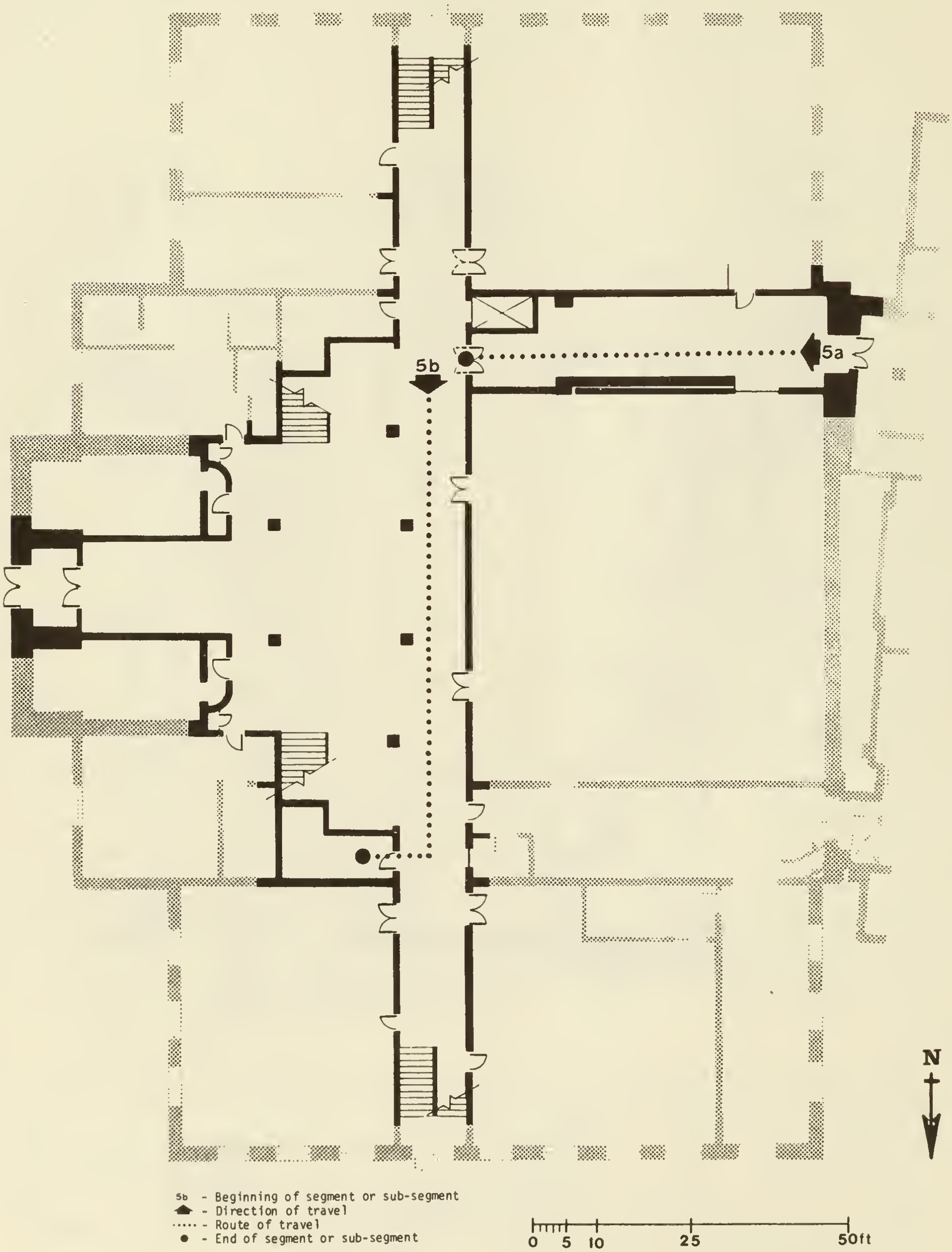
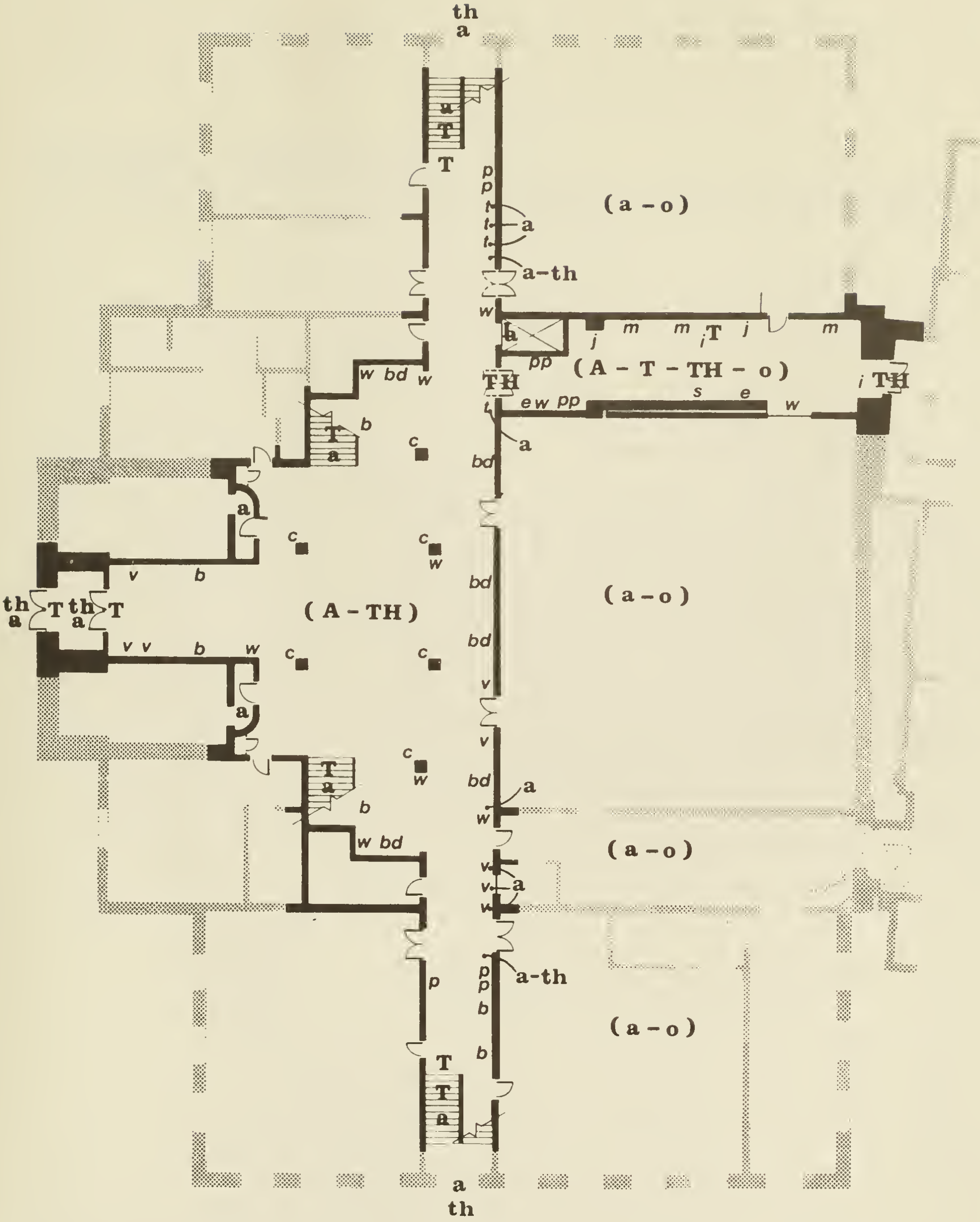



Figure 2.5.A: Segment 5

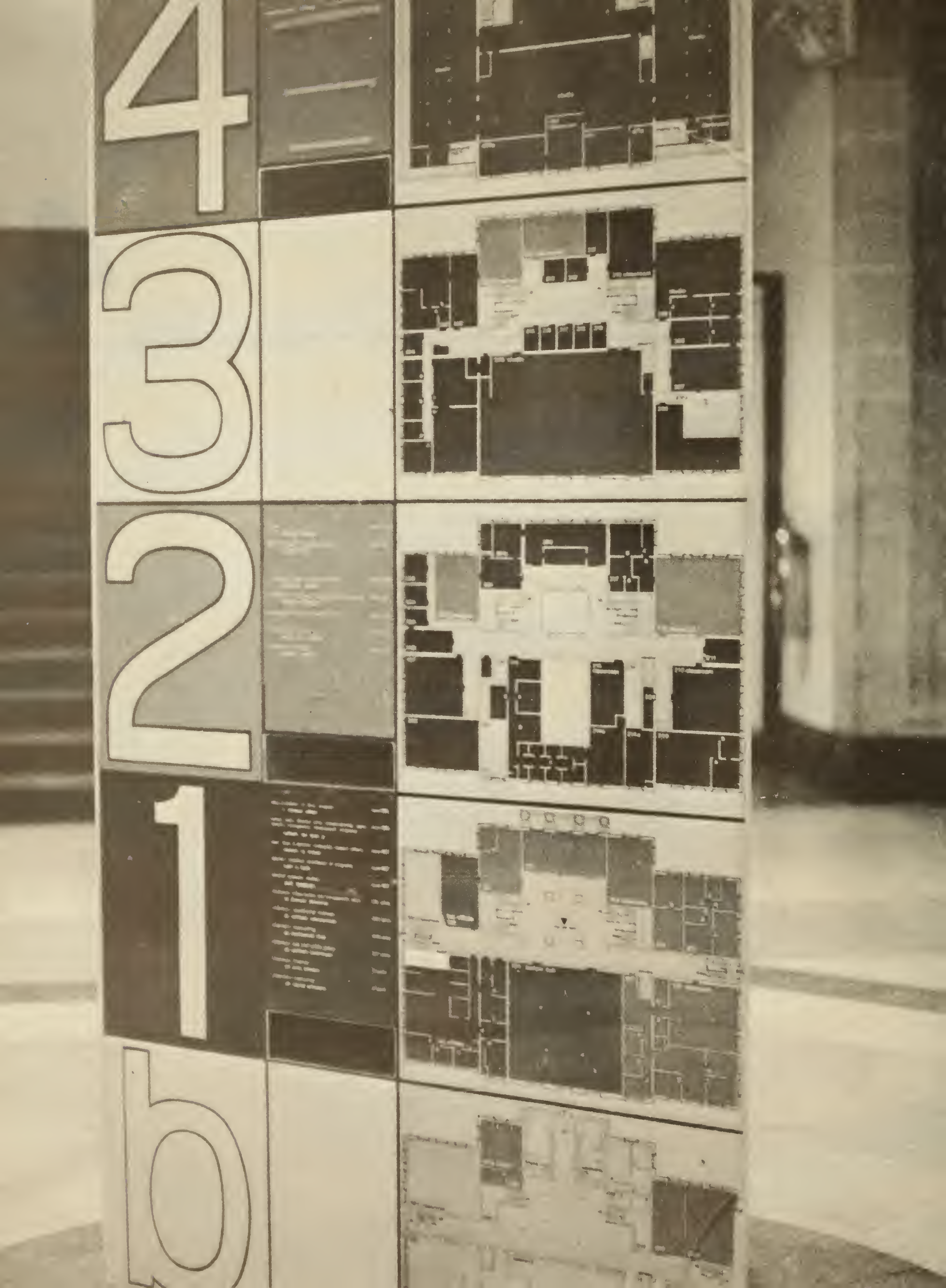



| Landmarks | | Information Points | Obstacles | |
|---|---|---|---|---|
| A | Auditory | a | b - Bench or chair (movable) | m - Machine |
| O | Olfactory | o | bd - Bench (movable) with overhanging display case | p - Vertical pipe (exposed) |
| T | Tactual | t | c - Column | s - Storage area or closet (added) |
| TH | Thermal | th | e - Electric circuit box | t - Telephone booth |
| | | | j - Janitor's closet (added room) | v - Vending machine |
| | | | i - Irregular floor surface level | w - Waste container |

Figure 2.5.B: Segment 5 - Landmarks, Information Points and Obstacles

# 4

# Design Workshop


4
3
2
1
b

## The Design Workshop

This section is based primarily on the results of discussions held during the design workshop which followed the completion of the first phase of field research.[5] The purpose of the workshop was to identify and discuss tentative building design modifications/standards that might be responsive to the mobility problems of the blind. It utilized the data base from the Phase 1 research and expert opinion to identify issues and propose solutions.

The discussions covered three design issues that had been identified after a review of the Phase 1 results and that we felt were within the realm of design standards: 1) warnings of imminent danger, 2) doors in public buildings and 3) standardized direction finding cues.[6] Also covered was the target population--for whom the design standards were being developed.

Other issues raised, but not specifically discussed were: 1) the elimination of confusing, irregularly shaped areas from public buildings (a situation that is difficult to eliminate--therefore, a subject for possible design guidelines rather than design standards), and 2) the reduction of unnecessary level changes (a subject to be covered in the ANSI Standard as a result of testing involving individuals with ambulatory problems).

During the workshop, each design issue was covered separately. The end result was the statement of a concept or set of concepts related to each issue. This section is organized by issue, and each concept is presented along with the major points discussed by the workshop participants.

Issue: Who is the target population?

*A broad population.*

Concept: Any design modification/standard that helps a broader population than just blind people is more practical and has a much better chance of being accepted in a standard or code.

Discussion: Buildings should be structured so that they help sighted as well as visually impaired persons. Designs aimed at helping only those with severe loss of vision might be too impractical or costly, or might produce obstacles to those without visual disabilities. The broader the population that such designs aid, the easier it will be to justify implementation.

*The blind population.*

Concept: Major emphasis should be placed on those traveling with cane or dog guide. Additional considerations should be given to those who are partially sighted and who travel visually.

Discussion: The overwhelming majority of those individuals with severe visual impairments travel with long cane or dog guide. At present, only a small number of individuals use electronic mobility aids. Therefore, inclusion of this group into the design population is not warranted at this time. It is felt, however, that design that aids the cane and dog guide users would aid this group as well. Regarding the partially sighted/ visual group, design concerns should focus primarily on color schemes and lighting arrangements.

Issue: Warnings of imminent danger.

*Consistency in application.*

Concept: Consistency in signals is extremely important. Without consistency there are no standards. We should require consistency within buildings.

Discussion: Consistency within buildings is necessary. Consistency between buildings is very difficult to control. However, if general guidelines are followed in all buildings, an acceptable level of consistency will be attained.

*Uniqueness of warning signals.*

Concept: The warnings should be unique to only those uses specified in the standards and should be differentiated from materials used in other parts of the building.

Discussion: Differentiation of materials is necessary to prevent confusion. Also, from an orientation standpoint, this is extremely beneficial, as the material will not only serve as a warning signal but as a guiding device as well.

*Need for warning signals.*

Concept: Warnings should be placed before any dangerous change in level (staircases and escalators) and before drop offs (railway, subway and loading platforms).

Discussion: If warnings are placed indescriminantly, the concept of standardized warnings is lost. For example, warnings need not be placed near benches, planters, posts and statues (logical placement of these objects out of main circulation paths is recommended in these cases), ornamental pools (pool edges should never be flush with the surface, but should be raised at least 6 inches--150 mm--from the surface), or at entrances or exits. Warnings should be placed where there is a danger of a falling hazard, e.g. in front of a staircase going down, directly in the main circulation path. From an orientation point of view, limited and consistent application of warning signals would also be beneficial. Indiscriminant use would lead to confusion. Cost is an important factor to be considered when recommending the use of warning signals. For example, placement of cues by or near elevators would aid orientation but would be very costly. Another important factor is aesthetics. If

materials are recommended that are not aesthetically pleasing, then many designers might not readily accept the concept of warning signals. Therefore, recommending the use of warning signals only when they are necessary for safety will help overcome arguments that they are too costly or aesthetically unpleasing. Also, it should be stressed that something can be both functional and aesthetically pleasing at the same time.

*Nature of warning signals.*

Concept: The warnings should be reasonably oriented, both tactually and visually. The type of cue used may vary depending on the danger involved, although variations must be made consistent with other parts of the standards. Changes in the texture of the floor surface seem to be the best type of warning to use. We should not recommend a texture but a choice of different related textures. Consistency, however, must be maintained within buildings, given a specified list of textures. The textures must be unique to only those environments specified in the standard and should be differentiated from other parts of the building.

Discussion: Blind travelers are tactually oriented, although consideration must be given to the partially sighted. Changes in the texture of the floor surface offers a double warning system because they can be sensed with both cane and foot. Non-tactual cues, such as air blasts, introduce mechanics into the picture. Installation and repair costs preclude the use of mechanical devices. Also, if mechanical breakdowns occur, the cues are no longer valid. Cues such as air blasts may also be offensive to consumers. By offering a choice of a "class" of texture changes, the conflict between function and aesthetics will be lessened. Designers who might not accept a standard choice might be more willing to accept one of a number of choices. The type of texture change to be used is a function of cost of installation, cost of maintenance, availability of materials, architects' knowledge of available materials and aesthetics.

*Size and configuration of tactile warning signals/the strip warning.*

Concept: One type of floor surface cue that could be used is the strip warning. This should be a non-slip material placed at the top of level changes and near drop offs. The strip(s) should be placed parallel or perpendicular to the hazard and should be raised.

Discussion: One strip or a few narrow strips may not be enough to give ample warning, and may be missed by the blind traveler. Strips that are placed parallel to the edge of a hazard (e.g. a staircase) might blend in with the staircase and become a hazard to sighted and partially sighted travelers.

*Size and configuration of tactile warning signals/the area warning.*

Concept: An area texture change is the second alternative regarding

warnings of imminent danger. Surface changes of this type should be placed at the top of level changes and near drop offs. The cue should be a non-slip material and should be a different texture from the rest of the surface.

Discussion: A large area would be more advantageous than a strip because it would give more warning. However, too much of an area would be costly, potentially unpleasing from an aesthetic point of view and possibly confusing to the traveler. The cue should be large enough for the traveler to sense it, react to it and come to a complete stop at a position where he or she is approximately one step from the first encounter with the hazard.

*The handrail as a warning signal.*

Concept: Handrails may also be used to cue changes in levels. Extending handrails and leveling them off at the top and bottom of level changes is sufficient warning. Handrails should also be a color which contrasts with the color used on the walls on either side of the staircase. Handrails should continue along landings in order to cue the continuation of the staircase. The extensions should not be too long--12 inches is an appropriate length. Long extensions might protrude into paths of travel and might be aesthetically unpleasing. Cost is a factor regarding extensions along landings--expense of material is approximately $20. per 18 inches (455 mm). There is no need to change the texture of the handrail near the top and bottom of the level change. A leveling off of the railing is a sufficient cue.

*Placement of warning signals.*

Concept: We might not be able to dictate the materials to be used as warnings, but we might be able to standardize distance away from the danger, the raise of the cue from the floor surface and the depth and width of the cue. These measures may vary depending on the hazard, although too many variations would ruin the concept of a standard.

Discussion: The distance away from the hazard may vary, depending on the danger involved. Distances should be standardized and should be consistent with other parts of the standard. For example, a cue might be installed 18 inches (455 mm) from the top of a staircase being approached head on, but only 6 inches (150 mm) from the top of a staircase going off the left or right of the main path of travel. Another constraint on the distance variable is the size of the hazardous area in question. If the area is small, a change in the texture of the entire area might be appropriate, whereas, in a larger area, a strip warning placed at a standardized distance from the object may be more appropriate than an area change. Cues should be given early enough so that the mind and body are alerted to the upcoming change. Pace, body motion and cane techniques must be considered. If the cue is too far away from the hazard, or too close, the body rythm might be interrupted. The pace of a blind person is a bit slower, for the most part, than the pace of sighted individuals. There is also a difference in pace between

cane and dog guide users. Cues should come in time for the user to sense, react and stop so that the cane is just about ready to touch the hazard in question. The dog guide can be trained to respond to warning signals in an appropriate manner, if the signals are standardized.

Issue: Doors in public buildings.

*General statement.*

Many door problems are training ones. Visually impaired individuals are taught how to approach and open doors, but they ususally don't use the correct method in practice. Because of the many variables involved, it is felt that this area might be too ambiguous to research or cover in the standard at this time.

*Glass vs. solid doors.*

Concept: Glass doors might be used to eliminate the problems encountered when a blind person approaches a door from one side while another person is opening it from the other side.

Discussion: It is questionable as to whether a clear door would insure that sighted persons would react appropriately, even if they noticed a visually impaired person coming from the opposite direction. People are generally not perceptive enough to respond correctly. There is also a safety problem regarding large areas of glass in doors. They are difficult to see and must be heavily marked with opaque markings. A solid door with a clear side light panel, running from ceiling to floor and placed to the side of the door might be helpful, although it is doubtful whether this would solve the problem.

*Entrances and exits/direction of opening.*

Concept: Doors should open away from the direction of travel. Two-leaf doors are a way to improve traffic flow and alleviate difficulties incurred by the visually impaired traveler. A standard rule that would be useful might be that: "One should always go through the door on one's right, and that door will always open away from you."

Discussion: Again, this is an area which is best covered by training. Requirements calling for doors to open away from the direction of travel or for two-leaf doors at the entrances of all public buildings are unrealistic and unfeasible. However, when two-leaf doors are available at the exits, then it should be recommended that each be appropriately designated as either "in" or "out".

*Entrances and exits/automatic doors.*

Concept: It should be recommended that automatic doors be installed whenever possible and automatic sliding doors should be the first choice. If sliding doors cannot be installed, and if doors can be made

to open in the direction of travel, then conventional automatic doors may be used, with a guardrail installed to stop people from walking into doors that open into their path.

Discussion: This recommendation will get designers to think about the door problem in the early stages of building design. Automatic sliding doors have these benefits: 1) less floor space used by doors, 2) less materials needed and 3) better safety for visually impaired people. The cost of sliding doors, however, may be prohibitive in that more wall space is needed to install the doors, the equipment is more expensive and structural costs are higher. Material and structural costs for installing conventional automatic doors are less. Also, the amount of frontage necessary for their installation is considerably less. If guardrails are needed, conventional automatic doors may cost more than sliding doors. The final conclusion on swinging versus sliding doors is related to the type of building, amount of traffic flow and specific design features surrounding the doorway.

*Entrances and exits/outside landings and steps.*

Concept: There should be no steps immediately outside of a doorway (e.g. high threshold). When the door opens outward, there must be a platform so that the traveler can become oriented to the stairs, and proceed safely to the sidewalk.

Discussion: Such requirements are presently in the ANSI Standard.

*Entrances and exits/covered areas outside the exit.*

Concept: It should be recommended that areas just outside building exits be covered.

Discussion: This adds weather protection for everyone. It also helps the visually impaired person become oriented to the doors through sound cues which can be used to determine the location of the doors and their proximity to the traveler.

*Entrances and exits/double doorways with vestibules.*

Concept: Where there are two sets of doors and an intervening vestibule, there should be enough space between the doors so that the traveler can open the second door without having to worry about holding the first door open, or having the door close on him or her.

Discussion: This is being included in the revised standard for other reasons. This also applies to indoor areas (for example, bathrooms) where this design is employed.

*Door knobs, levers and bars.*

Concept: This applies to all doors in buildings. The height and location of knobs, levers and bars should be standardized. Levers are

preferred over knobs. Door opening mechanisms which are located on fire doors should be tactually recognizable.

Discussion: A standardized height and location of door opening devices would be beneficial to all travelers. Levers are easier to grasp and operate than knobs. A roughened surface on parts of an opener coming in contact with the hands would be useful in helping the blind traveler differentiate between doors. Furthermore, it is felt that doors to unoccupied hazardous areas should be kept locked at all times.

Issue: Standardized direction finding cues.

*Purpose.*

The object of standardized direction finding cues is to help the blind traveler get from the building entrance to some destination in that building with a minimum amount of difficulty.

*Building orientation.*

Concept: The most important issue is to get into the building and to an identifiable and reliable source of information--a person, phone, map or directory. The reliable sources must be installed or placed in a standardized location in all public buildings.

Discussion: Whatever the source, it must be located in a standardized place in all public buildings. Standardized locations might be designated for each building type. In public buildings, the source might be located inside the main entrance, on the right or left side, out of the main flow of pedestrian traffic. Multi-entrance buildings pose a problem, however. Should a source be located at each entrance or at a centralized location? If it is located where all main paths intersect, then the situation may become confusing and chaotic. There should be a distinction in application between public buildings in which independent travel is possible and those in which assistance is absolutely necessary. Sighted guides should be used in air, train and bus terminals. In these buildings, independence should be put aside and aid should be accepted. A guideline for being a sighted guide might be developed to aid in the implementation of these recommendations. If sighted guides aren't provided, and independent travel is possible, then an information service is recommended with explicit directions, given either in person or over a phone. In these cases, instructions must be very specific and there must be standardized methods for giving them. A guideline for giving directions mignt be developed to aid in the implementation of the recommendations. There are two types of building directories that might be considered: tactual and auditory. Tactual directories are difficult to construct and are used infrequently. Auditory directories might be more feasible, if reliable information is presented to the traveler. The use of tactile maps is another possible method for providing information for the traveler. However, there are many problems associated with their construction and use and further

research is needed before recommendations regarding their applicability can be made. Further research is also needed regarding auditory directories and maps. Standardized methods regarding the type of information given and the method in which it is presented should be investigated.

*Circulation in public buildings.*

Concept: Circulation problems are very difficult to control. However, straight corridors and right angle (90 degree) intersections should be the standard, even if a building is irregularly shaped. Artificial aids or cues for identifying intersections are not necessary.

Discussion: There are a number of possible solutions to the circulation problem; that is, the problem of guiding a traveler from one point to another within a building. The concept of the color coded pathway, as used in a number of institutions such as the VA Hospital in Syracuse, might be modified to provide orientation cues. These cues could be tactile (floor surface change), auditory or thermal (use of the air handling system). However, these systems would be extremely costly at this time. Also, the concepts are not developed enough yet to even present as a recommendation. Further research is required in this area. Although it is very difficult to legislate right angles, given architectural styles and difficult building sites, perpendicular intersections should be recommended. Jogs in hallways should be eliminated, or slightly curved if they cannot be designed out. The consensus is that the use of textured pathways, tracks, or thermal or audio cues to indicate either line of travel in corridors or the existence of intersections is not necessary. If a person is properly trained, he or she will use all of the existing cues to negotiate these areas.

*Elevators.*

Concept: Raised numbers should be used on or next to elevator buttons or control panels and should be located on the outside door jamb of the elevator on each floor.

Discussion: The sighted and partially sighted should also be considered and signage should enhance readability for this group. Raised Arabic and Roman numerals and letters are preferred over braille because of the very small population that uses braille. However, both might be used in special situations (e.g. institutions serving the blind). Also, special symbols for stop, door open and door close might be developed. Further research regarding the size and raise of the figures is necessary before making recommendations.

# Phase 2

# 5

## Detailed Methods and Findings - Phase 2

### Purpose

The second phase of the field research was conducted in a controlled environment. Laboratory experiments were designed to explore variables in the design of tactile warning signals that were recommended at the Phase 1 design workshop.

### Participants

A subgroup of eight participants in the Phase 1 research participated in Phase 2. Individuals were selected if: 1) they traveled using the long cane, 2) they were average travelers, based on performance in Phase 1 and 3) they chose to participate further.[7]

The average age of the subgroup was 28 years (somewhat less than the total group's average of 42); the oldest was 45 and the youngest was 20. Six individuals were congenitally blind (two totally and four partially), and two were adventitiously blind (one totally and one partially). The five participants who were partially sighted do not travel visually but have some degree of either light, color or object perception or a combination of the three, although to a much lesser extent than a number of people who participated in Phase 1. All but one had some formal mobility training. The group included rote and independent travelers.

### General Methods

There were six procedures in the laboratory experiment. Procedure 1 was designed to test pace (defined as two steps), gait (number of feet/minute) and stopping distance. Procedures 2 through 6 were concerned with floor signal recognition. Two trained observers were present during each session and observations and responses were recorded on a standardized form.

### Procedure 1: Walking Performance

The station for this procedure consisted of a straight route, 25 feet in length, on a concrete floor (see Fig. 3). A mat made of short-nap carpet with a rubber backing was placed at each end of the run. Grid lines were marked on the carpet. The participants were positioned on one of the mats with the toes of both feet on the zero line. They were then told to walk straight ahead until they felt a floor signal similar to the one on which they were standing (with either cane or foot). When they felt the signal, they were told to stop and remain in a stationary position. The participants were told that there were no obstacles in or along their path. They were asked to walk at their natural pace and not to stop abruptly. This procedure was repeated at least two times for each individual.

In order to calculate the pace for each repetition of the procedure, 20 feet (length of run) was divided by half the number of steps needed to

traverse that distance (a pace is two steps). Gait was calculated by dividing the time in seconds it took to walk the first 20 feet of the run into 60 seconds, and multiplying the result by 20 to give feet/minute (see Table 1).

Stopping distance was calculated in the following manner: 1) the observer made note of the number of steps that it took to stop after he or she sensed the signal, 2) this value (converted into paces) was then multiplied times the average pace length for each person. The resulting value was the stopping distance for that particular repetition. Since the steps taken when coming to a stop were usually smaller than normal walking steps, the stopping distance is actually less than the experimental value derived by the calculation above. The experimental value would never be exceeded, even at a very abrupt stop (see Table 1).

Other data noted during this procedure were: 1) cane technique (diagonal or touch), 2) whether body motion was interrupted when the participant felt the signal and stopped (i.e. did they lunge forward or go off balance), 3) the position of the cane and 4) right and left feet on the grid (this was used to calculate the distance between the cane and the forward foot after the person stopped). Following completion of the procedure, the results for each calculated value were summed and divided by the number of repetitions of the run to give average values. Table 2 lists the most important results for Procedure 1.

Procedure 2: Raise

This procedure was designed to determine the minimum raise that a signal would have to be in order to be detected by a traveler, either with the cane or with the feet. Figure 4 shows how the experimental testing station was designed. The materials that were used and their placement on the floor surface are shown in Table 3.

Each participant was placed at a different, randomly selected distance (one or more feet) from the first signal, and was told to walk straight ahead from that spot. Each was then told to stop when a floor signal was sensed, either with cane or feet. If the first signal was sensed, each participant was told to proceed to see if the remaining ones could be sensed. The procedure was repeated at least two times.

The observer made note of the cane technique, the signals that were sensed and the method by which they were sensed, i.e. cane, feet or both. After the procedure was completed, the participants were asked which of the signals they thought was the easiest to feel and why. Table 4 shows the results of this procedure.

The results indicate that signal 4 performed slightly better than did 2 and 3. Signal 4 was also seen as the easiest to sense by all of the participants who answered the question. Reasons given for ease of detection were resiliency of the material, its texture and the height of the raise. The results also show that the diagonal method was more efficient, as there was a minimal number of "no contacts" during the

testing runs. One qualification must be made, however, regarding the testing procedure; that is, the signals were only 36 inches wide. If they had been wider, the results would have shown a lower number of no contacts.

Procedures 3 through 6: Configuration

Procedures 3 through 6 were designed primarily to test signal configurations, and each procedure was repeated at least twice by each participant, going first in one direction and then reversing it. Prior to the beginning of this set of experiments, the participants were introduced to the materials that were being used as signals, and before each procedure they were told the general type of configuration that they would encounter.

They were then located as in Procedure 2, at a randomly selected distance from the signals and were told to proceed straight ahead until they sensed a floor signal, either with their cane or feet, at which point they were to stop. If they sensed the first signal in each procedure (in all but Procedure 6), they were told to proceed to see if they could or could not sense the remaining ones.

The observer made note of the cane technique, the signals that were sensed and the method by which they were sensed, i.e. cane, feet or both. After the procedure was completed, the participants were asked which of the signals they thought were the easiest to feel and why. In addition, for Procedures 3, 5 and 6 they were asked whether the direction of the strips or ribbing, relative to line of travel, made a difference in ease of detection.

Procedure 3 (abrasive strips):

The materials used in this procedure were one inch wide abrasive strips. The layout for this testing station is shown in Fig. 5. Table 5 illustrates the results for this procedure. The results show that signals 3-3 and 3-4 performed better than the other two. There is also evidence of learning, as detection improved with each successive encounter. Also, most of those who detected the signals did so first with the cane. Finally, there seems to be no significant difference in the detectability of signals when the data are categorized by cane technique.

Four of the participants had no preference regarding signal configuration. Of the four that did, two liked 3-3 the best and two liked 3-4. The reason for preference was that the size of the signal was better, i.e. the larger areas were much better than the smaller ones. The participants also felt that this material could be a good signal for the feet of the traveler as well, although some found the abrasive surface unpleasant to walk on.

Procedure 4 (abrasive areas):

An abrasive material, arranged so as to cover different areas, was used in this procedure. The layout of the testing station is shown in Fig. 6. Table 6 shows the results for this procedure.

The results show that all three cues performed about the same. Most participants sensed the signal with their cane, but cane technique did not make a difference. Three consumer testers had no preference regarding signal configuration. Of those who did, four liked the larger, solid signal, 4-2. They also felt that the 6 inch break in signal 4-3 was confusing and not very helpful. Only one participant preferred signal 4-3 over the others.

Procedure 5 (small area mat):

Two 6 inch by 36 inch pieces of ribbed rubber mat were used in this procedure. The mats were arranged so that the direction of the ribbing relative to line of travel was different for each signal. Figure 7 illustrates the dimensions of the mat and the station layout. Table 7 shows the results for this procedure.

The results for Procedure 5 show that a little over one-half of the participants missed these narrow strips with their cane but detected them with their feet. When the data regarding detectability by cane are examined, signal 5-1 performed somewhat better than 5-2. The reason for this seems to be the direction of the ribbing, i.e. it is perpendicular to the line of travel. This finding was also reflected in the preference question, as four of the five that stated a preference opted for signal 5-1 because of the direction of the ribbing.

Procedure 6 (large area mat):

One 5 foot by 5 foot piece of ribbed rubber matting was used in this procedure. Participants approached the mat from two directions to see if the direction of ribbing relative to the line of travel made a difference. Figure 8 illustrates the mat's dimensions and the station's layout.

All of the participants sensed the signal coming from both directions, with both cane and feet. Seven of the eight detected the difference in the direction of the ribbing, and three of the four who stated a preference liked the ribbing the best when it was perpendicular to the line of travel because it produced a washboard effect when encountered by the cane.

Overall Preferences and Comments

After completing all of the procedures, the participants were asked: 1) to indicate which signal or group of signals would be most helpful in warning travelers of upcoming dangers, 2) if there were any other types of floor surface materials that they felt would be useful as a signal

and 3) whether there were any types of floor surface materials that they had strong negative feelings about.

All of the clients preferred the larger area rubber matting. Reasons given for this choice were: 1) a larger area provided more of a warning than a smaller one did, 2) the texture (ribbing) and the resiliency of the material made the signal distinctive relative to the floor surface, and 3) the rubber provided a distinctive sound change relative to the floor surface.

A number of surfaces such as carpet, wood and metal slats were mentioned as possible warnings of imminent danger. However, the consensus of the consumer testers was that any distinctive change in the floor surface would be helpful, as long as it was consistently applied.

In answer to the question regarding floor surfaces that they didn't like, the participants named masonry and ceramic tile floors. The problem with these surfaces is not the material itself, but the spaces between each individual brick or block--spaces in which travelers catch their canes.

## Analysis, Conclusions and Recommendations

The results of the laboratory experiment indicate that there are at least five important factors to be considered in design of tactile warning signals: 1) the height of the raise, 2) type and texture, 3) material contrast between signal and floor surface, 4) depth of signal and 5) color of signal and placement.

Raise:

The signal should be raised from the floor surface at least 1/16 inch, but no more than 1/8 inch. Although a cue with a raise of 1/32 inch was sensed during the experiment, the number of misses was sufficiently large enough to conclude that a slightly higher raise should be recommended as a minimum. This would raise the probability of signal detection to a more acceptable level. On the other hand, signals raised more than 1/8 inch are considered unacceptable because they can become tripping hazards. In fact, the building maintenance industry tends to avoid materials with a raise greater than 1/8 inch.

Type and Texture:

A signal covering a large area is more acceptable than a signal consisting of a single, narrow strip. In addition, a patterned or roughly textured material is more acceptable than a non-patterned one.

Material Contrast:

There should be a recognizable contrast between the signal and the floor surface. Therefore, materials used as signals should be considerably harder or softer than the floor surface. Table 8 shows a

comparison of materials based on the above criteria. The contrast in materials affects the size of the signal. The higher the contrast, the smaller the signal needs to be. Conversely, the lesser the contrast, the larger the signal. For example, in the laboratory experiment, the rubber matting was placed on a cement surface. The contrast in materials is very high. In addition, the matting was a very resilient material. This resiliency added more to ease recognition by its feel and also by its sound as the cane touched it. Therefore, the signals performed very well. Had tiles been substituted for the rubber mat, larger areas would have been needed.

Depth of Signal:

The signal must cover a large enough area to have a high probability of detection. The critical dimension is depth, that is, the distance between the hazard and the beginning of the signal (see Fig. 9 ). The recommended range of signal depth is between 18 to 36 inches. These figures were arrived at by first examining the results of Procedures 2 through 6. From these data it was concluded that the 5 inch and 6 inch deep signals were unacceptable. On the other hand, the data from these procedures did not provide conclusive evidence as to the acceptability of the 11 inch and 12 inch signals. However, when the data from Procedure 1 (stopping distance--minimum 1.1 feet, maximum 4.0 feet, average 2.82 feet) were examined, the 11 and 12 inch signals also became unacceptable, because they did not provide enough time and space following detection to be efficient warnings. The data from Procedures 3 and 4 on the performance of the 16 and 18 inch signals indicate that these signals performed well primarily because they were deeper than the others and provided more time to sense, react and stop.[8]

Color and Placement:

No data were collected during this phase of testing that directly related to signal color and placement, although it was generally felt that the color of the signal should contrast with the color of the hazard, and that the signal should be placed at the top of each staircase and near the edge of any drop off or platform. To aid in determining color and placement, John Archea, of the National Bureau of Standards, was consulted (Archea, 1976 a, 1976 b, Note 9).

For staircase hazards, it was concluded that the signal should contrast significantly with the color of the hazardous area, but should be the same as that used on the approach to the signal. This would highlight the hazard and aid sighted and partially sighted persons in differentiating the hazard from the approach.

Signal placement was more difficult to determine. However, a general guideline was developed which states that there be an intervening area between the end of the signal and the beginning of the staircase hazard, and that the signal not end at the exact moment that the hazard begins. In addition, this area would be the same color as the hazard, so that attention can be focused on the upcoming hazard and away from the signal

(see Fig. 9 ).

These findings only apply specifically to signals used at staircases and not to those used at other hazards, such as intersections of walks and streets or on subway platforms. It is felt, however, that tactile floor signals can be utilized to warn of the other hazards as well as staircases.[10]

## Summary of Recommendations

Based on the analysis of results and discussions with consultants, the following are recommendations for design of warning signals:

1. Signals should be raised at least 1/16 inch but not more than 1/8 inch.
2. Signals should be patterned or roughly textured and cover an area.
3. There should be a recognizable contrast in resiliency between the material of the signal and the material used on the floor surface.
4. The signal should be between 18 and 36 inches deep and should be installed along the boundary of the hazardous area, except at stairways where an intervening area between the end of the signal and the beginning of the hazard should be provided.
5. The color of the signal should be the same as the surface of the approach, but contrast significantly with the color of the hazard.

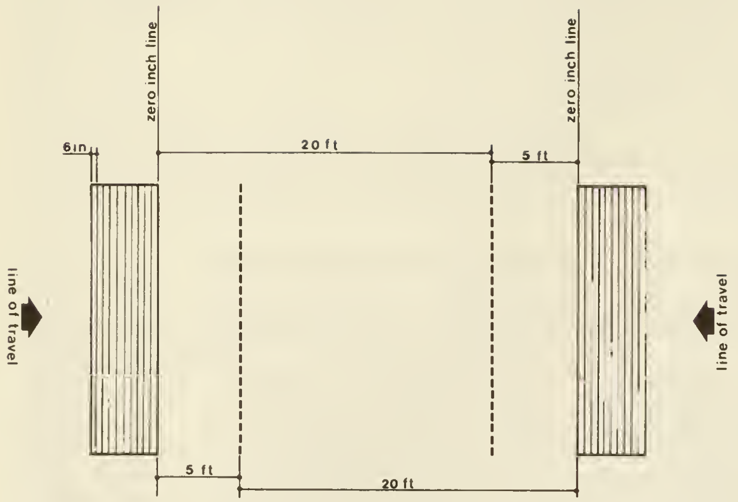



Figure 3: Phase 2 - Procedure 1 (drawing not to scale)

Table 1: Example Calculation of Pace, Gait and Stopping Distance

Pace

1. Number of steps to walk 20 ft = 13 steps
2. Pace = 20 ft/(1/2 x 13 steps) = 20 ft/6.5 ft = 3.1 ft/pace

Gait

1. Time to walk 20 ft = 8 seconds
2. Gait = (60 sec/m/8 sec) x 20 ft = 150 ft/m

Stopping Distance

1. Number of steps between signal sensed and place where person stopped = 1 step = 1/2 pace
2. Stopping distance = 1/2 pace x 3.1 ft/pace = 1.55 ft

Table 2: Results for Phase 2-Procedure 1/Pace, Gait and Stopping Distance (N = 17 trials by 8 consumer testers)

| | Average | Minimum | Maximum |
|---|---|---|---|
| Pace | 3.7 ft | 3.1 ft | 4.5 ft |
| Gait | 182 ft/m | 164 ft/m | 186 ft/m |
| Stopping Distance | (less than)2.82 ft | (less than)1.1 ft | (less than)4.0 ft |
| Distance Between Forward Foot and Cane After Stop | 20.9 in | 3.0 in | 37.0 in |
| a. touch technique only (N=11) | 27.4 in | 37.0 in | 18.0 in |
| b. diagonal technique only (N=6) | 9.0 in | 3.0 in | 13.0 in |

Table 3: Materials and Placement for Phase 2-Procedure 2

| Material | Raise (in in) | Description | Total Cue Depth | Cue Width |
|---|---|---|---|---|
| 1) Masking tape (2 layers) | 1/64 | 6 - 1x36 in strips at 1 in intervals | 11 in | 36 in |
| 2) Abrasive strips | 1/32 | 6 - 1x36 in strips at 1 in intervals | 11 in | 36 in |
| 3) Abrasive area | 1/32 | 1 - 12x36 in area | 12 in | 36 in |
| 4) Ribbed rubber mat | 1/8 | 1 - 12x36 in area with ribs running perpendicular to line of travel | 12 in | 36 in |

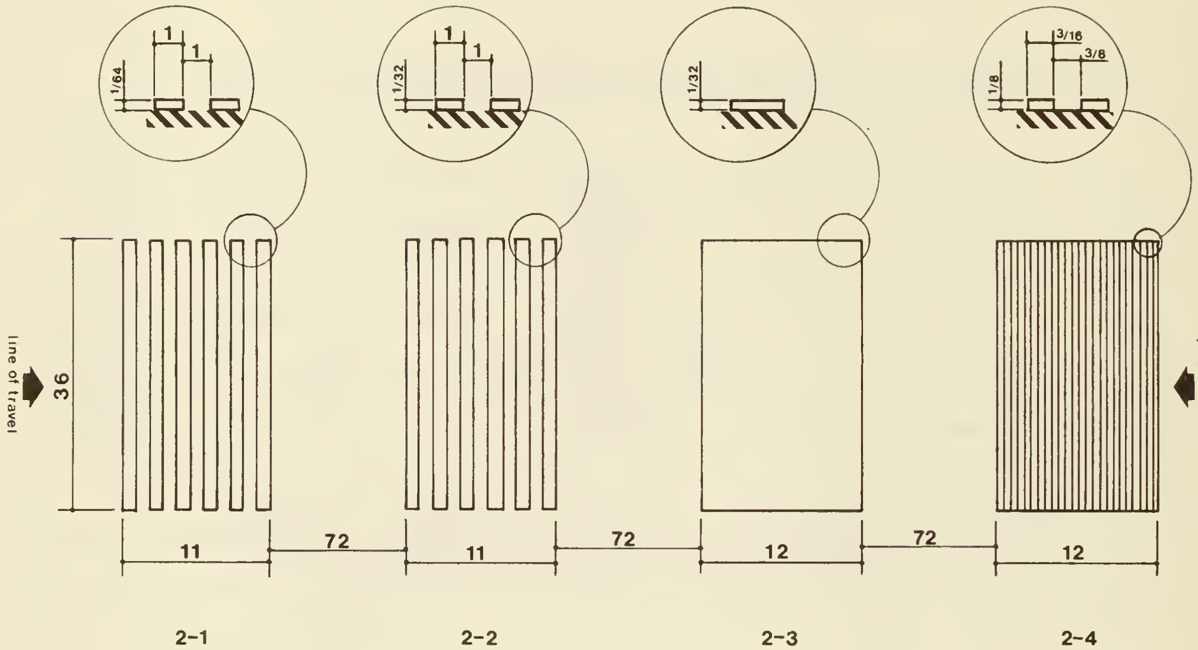



Figure 4: Phase 2 - Procedure 2 (drawing not to scale/all dimensions in inches)

Table 4: Results for Phase 2-Procedure 2/Raise (N = 18 trials by 8 consumer testers)

| | Both Techniques Combined | | | | Diagonal Technique (N = 6) | | | | Touch Technique (N = 12) | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) | (1) | (2) | (3) | (4) |
| Signal sensed | 0 | 13 | 11 | 15 | 0 | 5 | 5 | 6 | 0 | 8 | 6 | 9 |
| Number of occasions not sensed | 18 | 5 | 7 | 3 | 6 | 1 | 1 | 0 | 12 | 4 | 6 | 3 |
| Easiest to feel[a] | 0 | 0 | 0 | 5 | - | - | - | - | - | - | - | - |

[a]Three individuals were unable to decide which signal they felt was the easiest to sense.

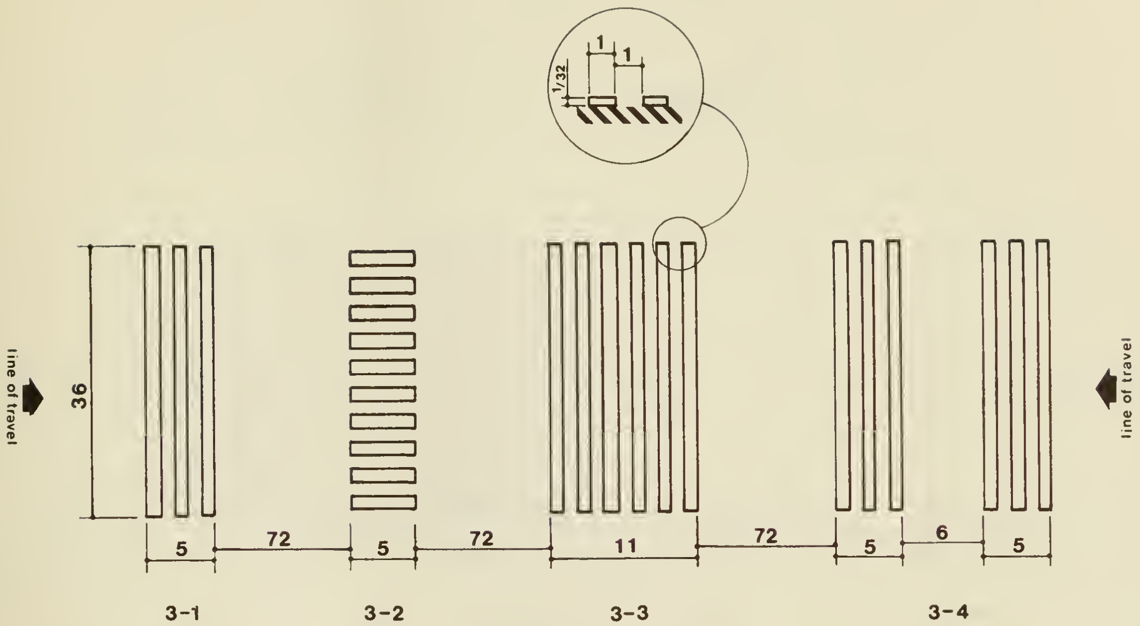



Figure 5: Phase 2 - Procedure 3 (drawing not to scale/all dimensions in inches)

Table 5: Results for Phase 2-Procedure 3/Abrasive Strips (N = 16 trials by 8 consumer testers)

| | Aggregate Data | | | | Primary Direction[b] | | | | Reverse Direction[b] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sensed by: | | | | Sensed by: | | | | Sensed by: | | | |
| Signal | Cane | Feet[a] | Both | Not | Cane | Feet | Both | Not | Cane | Feet | Both | Not |
| 3-1 | 4 | 2 | - | 10 | 1 | - | - | 7 | 3 | 2 | - | 3 |
| 3-2 | 6 | 1 | - | 9 | 3 | - | - | 5 | 3 | 1 | - | 4 |
| 3-3 | 10 | 2 | 1 | 3 | 4 | 1 | - | 3 | 6 | 1 | 1 | - |
| 3-4 | 7 | 3 | 2 | 4 | 3 | 2 | 1 | 2 | 4 | 1 | 1 | 2 |

[a] Sensed by feet only and not by cane.

[b] N = 8

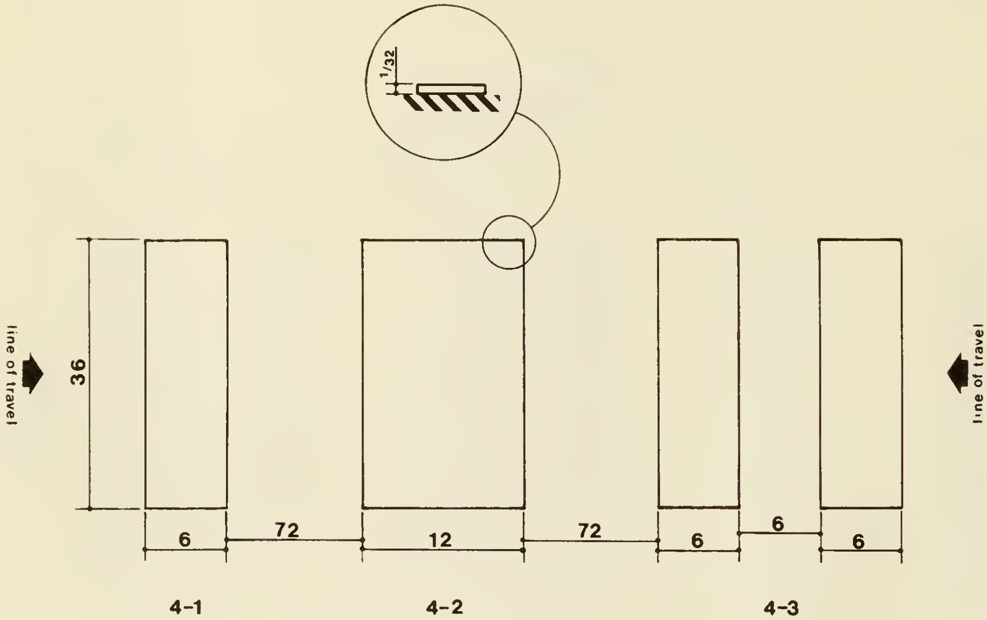



Figure 6: Phase 2 - Procedure 4 (drawing not to scale/all dimensions in inches)

Table 6: Results for Phase 2-Procedure 4/Abrasive Areas (N = 16 trials by 8 consumer testers)

| | Aggregate Data | | | | Primary Direction[a] | | | | Reverse Direction[a] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sensed by: | | | | Sensed by: | | | | Sensed by: | | | |
| Signal | Cane | Feet | Both | Not | Cane | Feet | Both | Not | Cane | Feet | Both | Not |
| 4-1 | 9 | 1 | 2 | 4 | 4 | 1 | 1 | 2 | 5 | - | 1 | 2 |
| 4-2 | 10 | - | 1 | 5 | 5 | - | - | 3 | 5 | - | 1 | 2 |
| 4-3 | 9 | 2 | 2 | 3 | 4 | 1 | 1 | 2 | 5 | 1 | 1 | 1 |

[a]N = 8

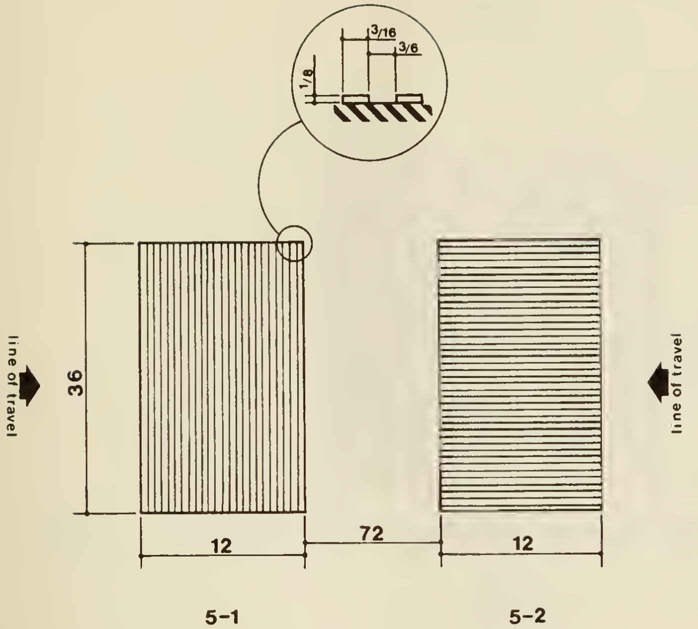



Figure 7: Phase 2 - Procedure 5 (drawing not to scale/all dimensions in inches)

Table 7: Results for Phase 2-Procedure 5/Small Area Mat (N = 15 trials by 8 consumer testers)

| | Aggregate Data | | | | Primary Direction[a] | | | | Reverse Direction[b] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Sensed by: | | | | Sensed by: | | | | Sensed by: | | | |
| Signal | Cane | Feet | Both | Not | Cane | Feet | Both | Not | Cane | Feet | Both | Not |
| 5-1 | 7 | 5 | 2 | 1 | 5 | 1 | 1 | 1 | 2 | 4 | 1 | - |
| 5-2 | 3 | 8 | 2 | 2 | 1 | 5 | 1 | 1 | 2 | 3 | 1 | 1 |

[a] N = 8

[b] N = 7

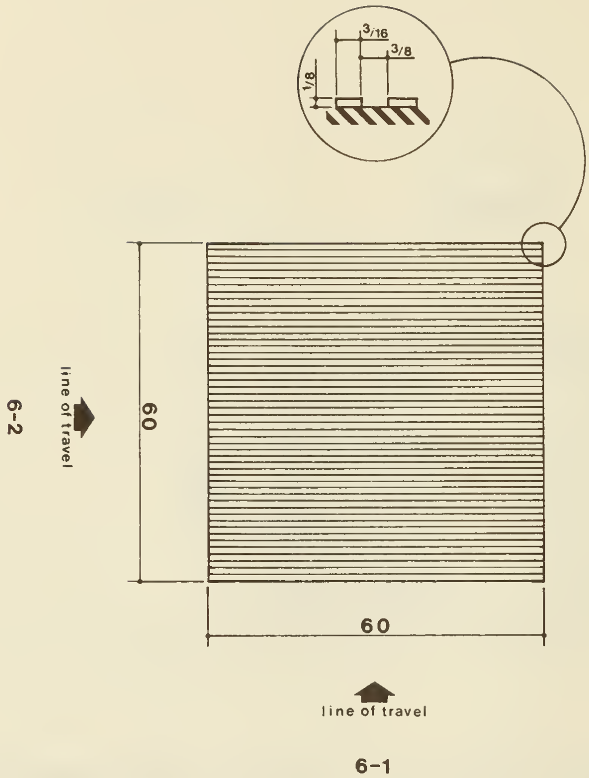



Figure 8: Phase 2 - Procedure 6 (drawing not to scale/all dimensions in inches)

Table 8: Signal/Surface Combinations with Perceived Differences in Hardness

| Signal Material | Walking Surface Material |
|---|---|
| concrete, asphalt | carpet, wood, resilient tile, sheet plastic, rubber or plastic cushion[a] |
| brick, quarry tile, stone | carpet, wood, resilient tile, sheet plastic, rubber or plastic cushion[a] |
| sheet plastic | all surfaces except resilient tile |
| rubber or plastic cusion[a] | all surfaces except tightly woven carpet with a short pile |
| carpet | all surfaces except rubber or plastic cushion[a] |

[a]e.g. cushioned tennis court surface

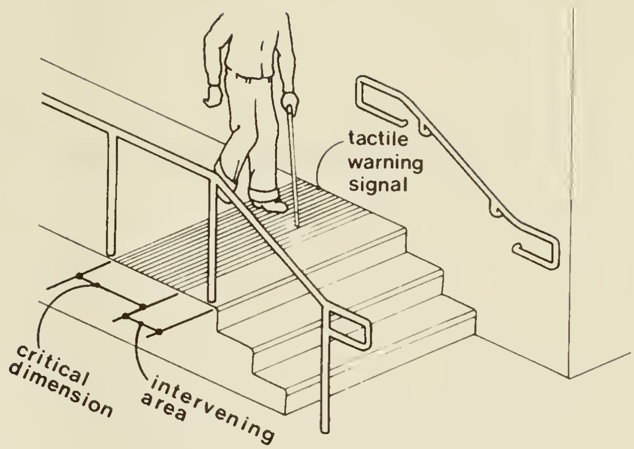



Figure 9: Example of a Tactile Warning Signal at Stairs Leading Down

# Phase 3

# 6

## Detailed Methods and Findings - Phase 3

### Purpose

The purpose of this phase was to test the recommended tactile warning signals in an actual building. In addition, an experiment was designed to test the use of raised numerals on an elevator control panel.

### Participants

Five participants were tested in Phase 3, all of whom participated in Phase 2. Each traveled using the long cane and was considered an average traveler, based on performance in Phase 1. Since the protocol was an important factor in Phase 3, individuals were chosen primarily on their ability to communicate their observations during the testing procedure.

### The Experimental Setting and Procedures

Three floor levels of Newhouse 1, a campus academic building at Syracuse University, were used in Phase 3-- level 1, level 2 and the basement level (see Fig. 10). The new route was chosen because it presented fewer problems than the route in Slocum and Link Halls, and it was hypothesized that it gave clearer orientation and mobility cues. Thus, confusion in the route would not interfere with warning signal recognition.

Tactile floor warnings were installed at the tops of all staircases along the route as per Figure 11. The depth of the signals varied, however, so that this aspect of the warning signals could be tested. A minimum depth of 18 inches and a maximum of 36 inches were utilized. In addition, a 36 inch square of the signal material was placed in front of the elevators on level 1 and in the basement (see Fig. 11).

Each testing session consisted of a prewalk briefing, a traverse of part of the building, two mapping exercises, a debriefing interview and a protocol of the route.[11]

Before proceeding with the walk, a briefing was held to explain each of the five procedures to be completed and to familiarize the participants with the material used as tactile warning signals and the raised numerals. Familiarization consisted of simply presenting samples of the warning signal material and the numbers to the participants and giving them some time to become familiar with them.

Prior to the beginning of Procedures 1 through 3 (in the case of Procedure 1, prior to each of the two segments), the participants were read a set of directions by the observer to help them negotiate the walk. Aid was given only when it was solicited or if a danger to the participant was perceived by the observer. Figure 11 shows the route used in the first four procedures by segment.

As the subjects proceeded through the route, their reliance on the tactile

warning signals and their performance in using the raised numerals on the elevator control panel were observed and recorded.

Procedure 4 was a straight-on approach to a down staircase, in front of which was installed an 18 inch deep floor signal. This procedure was designed to test the performance of the minimum depth in a situation where an individual approached a falling hazard head-on, and at full gait.

Following Procedures 1 and 3, participants constructed maps of the route, as in Phase 1. The final procedure in this session consisted of a protocol designed to help in constructing each person's image of the route. The participants again walked the route and were asked to provide a narrative of their impressions of the environment they were walking through. This narrative was recorded for later analysis along with the tactile maps, to obtain an idea of the participants' image of the Newhouse 1 route.

## Results and Conclusions

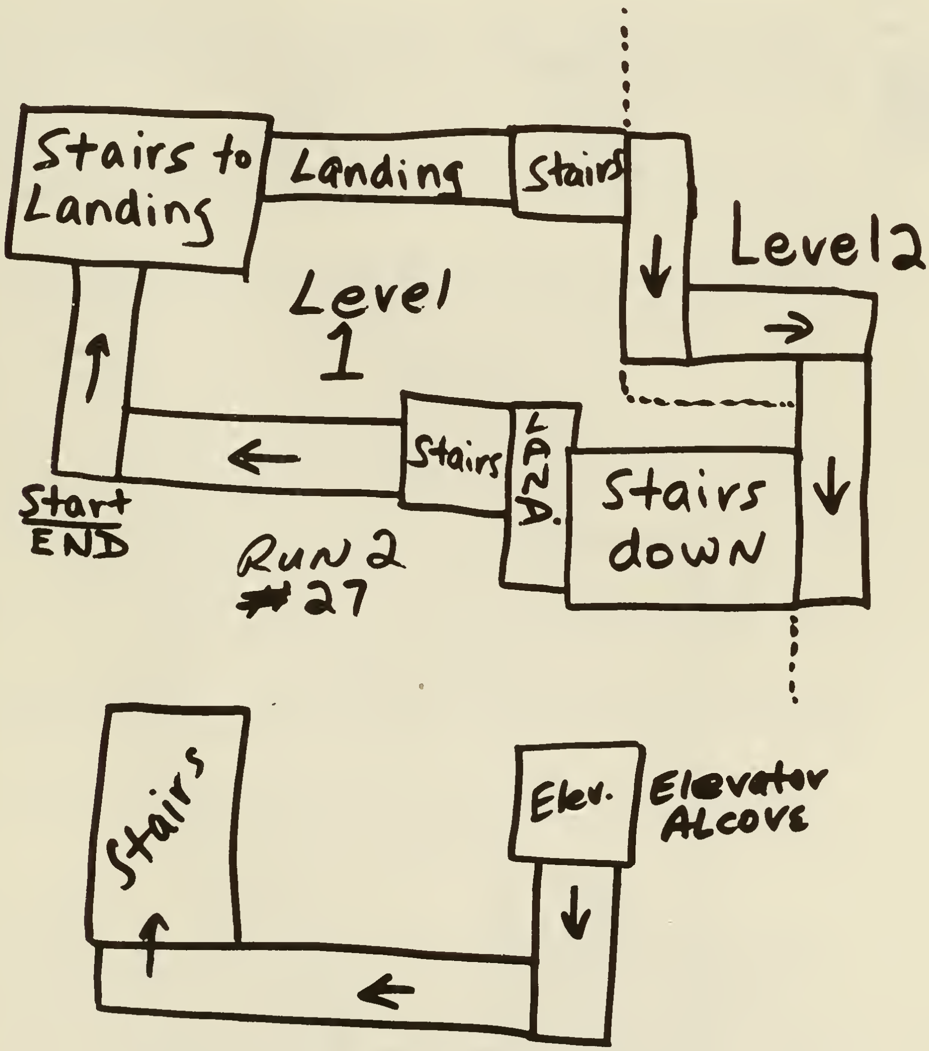
The results indicate that the 18 inch signal depth was sufficient in most cases to warn participants of upcoming falling hazards in this particular building. The occasion in which a deeper signal would have been better was in Procedure 4, where an 18 inch signal was installed at the top of a staircase that was approached straight on. In this case, a 24 inch signal would have been more acceptable. These results should be qualified by the fact that the ideal resiliency contrast (resilient rubber mat on terrazzo or granite floor) was maintained. Signals with minimum depth were possible in this situation, but the depth would have to be larger with less contrast.

In testing the raised numerals on the elevator control panel, it was found that some of the participants had not been trained in the use of Arabic characters; therefore, they found the raised numerals very difficult to use. However, all of these individuals felt that if Arabic numbers were used, they would learn their configurations and would definitely use them.

Those participants who did use the numerals found them difficult to read, although they were able, after some practice, to use them successfully. Their feeling was that the height of the numerals was acceptable (1/2 inch) but that the stroke width (stroke width-to-height ratio = 1/16 inch to 1/2 inch = 1:8) was too thick, thus causing a crowded figure that was difficult to read. A sharper letter was recommended, i.e. one with a larger stroke width-to-height ratio.

Although the hypothesis regarding building imageability was not directly tested in Phase 3, the results that were obtained seem to indicate that the Newhouse route was more imageable, and, therefore, easier to negotiate and map than was the Phase 1 route. The first major environmental factor which helped enhance the imageability of the Newhouse 1 route was the absence of large numbers of obstacles and noise to distract attention or mask other cues. Thus, the available environmental cues and landmarks were strong in stimulus value and were easy to read.

In addition, the symmetry of the building and the presence of strong and consistent edges over the majority of the route helped to improve the imageability of the building. In areas where these edges were weak, e.g. the first floor landing and open doorways near the staircases on the second floor, the participants encountered problems during the walk and afterwards when trying to map the route.



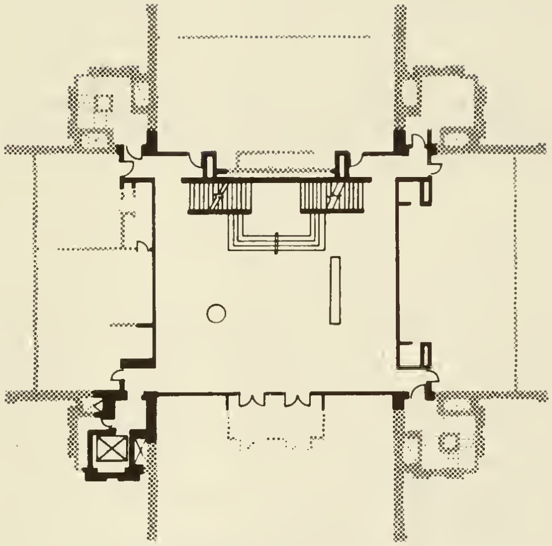


Figure 10.1: Newhouse 1 - Level 1

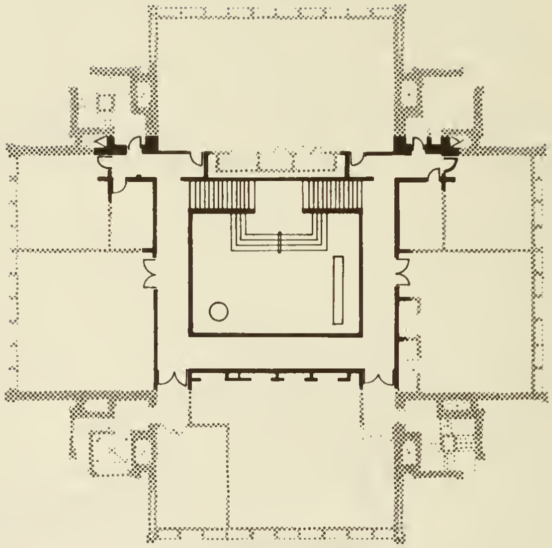
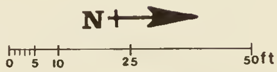


Figure 10.2: Newhouse 1 - Level 2



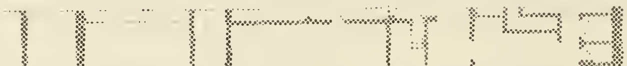



Figure 10.3: Newhouse 1 - Basement Level

Figure 10: Newhouse 1

## Phase 3 Briefing and Procedure Directions

There are 5 procedures in this session. During the first 3 procedures you will be following a route around the building, but our methods will be somewhat different from the ones we used during your first session at Slocum Hall. We will read you the directions before each procedure and repeat them, if you wish, so that you completely understand them before you begin.

A major goal of today's session is to test the effectiveness of our proposed tactile floor cues. The cues will be located at the top of all staircases and in front of the elevator. Some cues will cover a larger area than others. This is an example of the material we are using. (show and tell)

Now we'd like to give you a quick outline of each procedure. Procedure 1 has 2 segments and you will start and finish in the area you are now standing in. After completing this procedure, we will ask you to map the route that you walked.

During Procedure 2 we will be testing raised numerals on the elevator control panel and elevator door jambs. On this board we have an example of the characters that will be on the actual panel. This is not, however, an actual replication of the panel--the characters will be in different positions. (show and tell and test recognition)

Procedure 3 will be similar to the first procedure. You will be asked to follow a series of directions and walk a specific route. We will ask you to map the route at the end of this part also.

After the third procedure, we will review the first three, using a debriefing questionnaire similar to the one we used in Slocum Hall.

Procedure 4 is a short walk designed to test a tactile floor cue and it will not be mapped.

Procedure 5 is a "protocol". During this part we will walk the entire route again--informally. We will ask you to describe the building as we walk along and we will record your remarks.

Let us reiterate, as before, that we are testing the building and not your abilities. If you have any major problems we will be nearby. Any Questions? Let's begin.

Procedure 1 - Segment 1

You are now standing on a rug by the entryway of Newhouse I. Straight ahead of you is a staircase going up to the next floor. The staircase consists of a few stairs with a center railing leading to a large landing. Set back further on the landing and to your right are a larger number of stairs continuing up to the second floor. Tactile floor cues are located on the landing and at the top of the staircase. Please proceed straight ahead and all the way up to the second floor. When you get to the second floor turn right and stop. (Repeat.) At the top of the staircase you will receive directions for the second segment of part one.

Figure 11: Newhouse 1 Experimental Setting - by Procedure

## Phase 3 Briefing and Procedure Directions (cont.)

Procedure 1 - Segment 2

You are now on the second floor of Newhouse I. You are going to be walking three sides of a square and you will be making right turns. Please proceed straight ahead and turn right at each intersection. As you proceed around the square, you will feel a tactile floor cue on your right. This indicates that you have reached a staircase on your right which goes down to the first level. Go down the stairs to a landing. Turn right on the landing and proceed down another set of stairs and straight ahead to the carpeted area at the entryway of the building. (Repeat.) This will complete the first procedure.

Procedure 2

From this point, go straight ahead until you reach another carpeted area. When you reach the carpet, turn left and enter the elevator alcove. There is a tactile floor cue located directly in front of the elevator. The call button will be to the left of the elevator door. Push the up call button. (Repeat)

Now please press G. When the elevator stops, exit from it a couple of paces, turn right and stop. At this point, Procedure 2 will be completed. We will not be mapping this procedure.

Procedure 3

You are now on the ground floor of Newhouse I. Please proceed straight ahead and go out of the alcove and into the hallway. After you enter the hallway, turn right and go straight ahead. You will be looking for a down staircase on your right. A tactile floor cue is located at the top of the staircase. Please go down the stairs to the basement floor. There are handrails on both sides of the stairs. Please use the handrail. When you get to the basement, please stop. (Repeat.) At that point Procedure 3 will be completed.

Procedure 4

Straight ahead of you is a staircase. Please go straight ahead and down the stairs. There is a tactile floor cue located at the top of the staircase. Also, there are handrails on both sides of the stairs. Please use the handrail. Stop when you get to the bottom of the stairs. (Repeat.)

Procedure 5

This is the protocol. We will read you the directions again. While we are walking along, please give us a detailed description of the building.

## Key to Figure 11

1 - Beginning of procedure
1-1 - Beginning of segment
- Direction of travel
.... - Route of travel
• - End of procedure or segment
- Tactile floor signal
18 - Tactile floor signal depth or size (in inches) (in inches)

Figure 11: (cont.)

Procedure 1 - Segment 1

You are now standing on a rug by the entryway of Newhouse I. Straight ahead of you is a staircase going up to the next floor. The staircase consists of a few stairs with a center railing leading to a large landing. Set back further on the landing and to your right are a larger number of stairs continuing up to the second floor. Tactile floor cues are located on the landing and at the top of the staircase. Please proceed straight ahead and all the way up to the second floor. When you get to the second floor turn right and stop. (Repeat.) At the top of the staircase you will receive directions for the second segment of part one.

Procedure 1 - Segment 2

You are now on the second floor of Newhouse I. You are going to be walking three sides of a square and you will be making right turns. Please proceed straight ahead and turn right at each intersection. As you proceed around the square, you will feel a tactile floor cue on your right. This indicates that you have reached a staircase on your right which goes down to the first level. Go down the stairs to a landing. Turn right on the landing and proceed down another set of stairs and straight ahead to the carpeted area at the entryway of the building. (Repeat.) This will complete the first procedure.

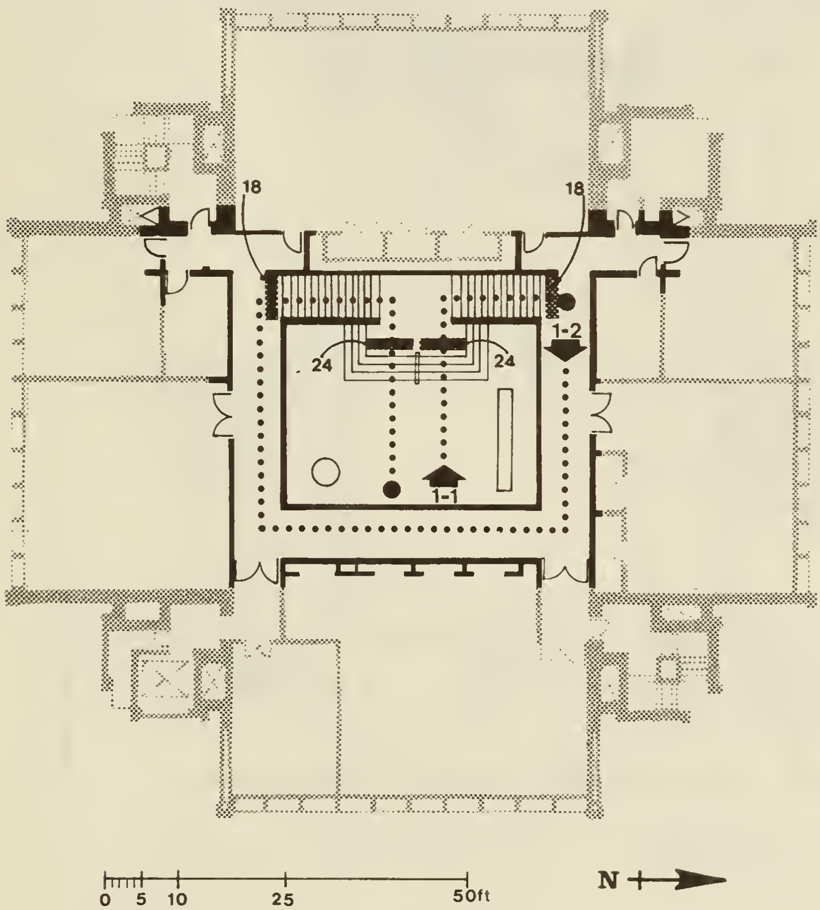



Figure 11.1: Newhouse 1 - Procedure 1

Procedure 2

From this point, go straight ahead until you reach another carpeted area. When you reach the carpet, turn left and enter the elevator alcove. There is a tactile floor cue located directly in front of the elevator. The call button will be to the left of the elevator door. Push the up call button. (Repeat)

Now please press G. When the elevator stops, exit from it a couple of paces, turn right and stop. At this point, Procedure 2 will be completed. We will not be mapping this procedure.

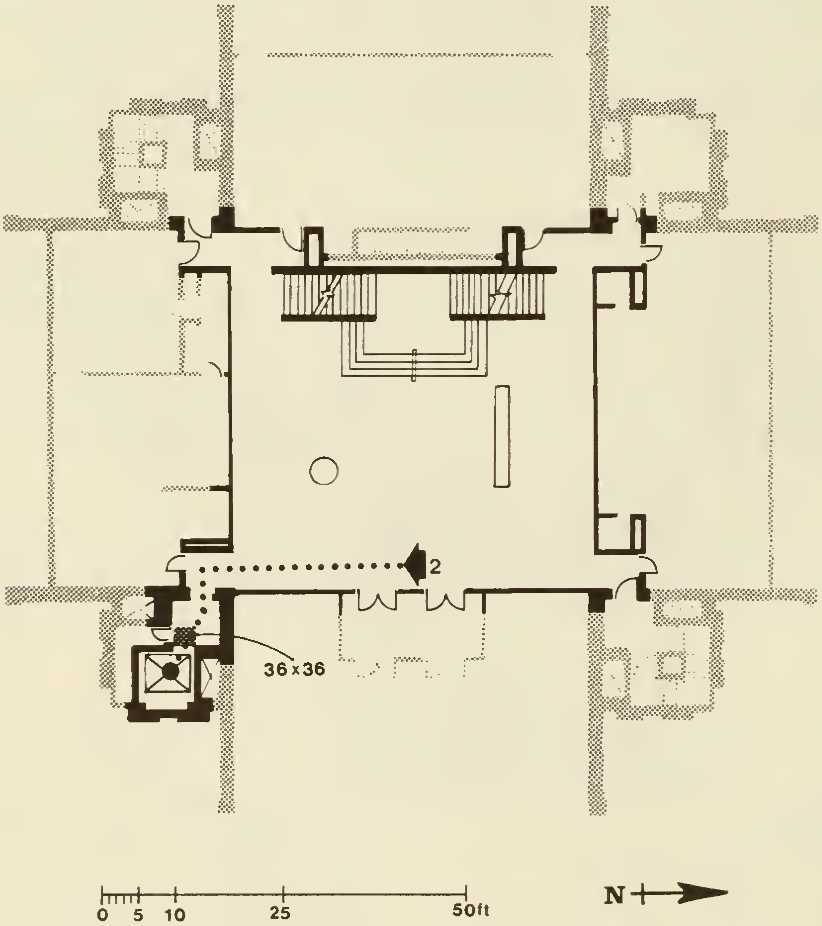



Figure 11.2 Newhouse 1 - Procedure 2

Procedure 3

You are now on the ground floor of Newhouse I. Please proceed straight ahead and go out of the alcove and into the hallway. After you enter the hallway, turn right and go straight ahead. You will be looking for a down staircase on your right. A tactile floor cue is located at the top of the staircase. Please go down the stairs to the basement floor. There are handrails on both sides of the stairs. Please use the handrail. When you get to the basement, please stop. (Repeat.) At that point Procedure 3 will be completed.

Procedure 4

Straight ahead of you is a staircase. Please go straight ahead and down the stairs. There is a tactile floor cue located at the top of the staircase. Also, there are handrails on both sides of the stairs. Please use the handrail. Stop when you get to the bottom of the stairs. (Repeat.)

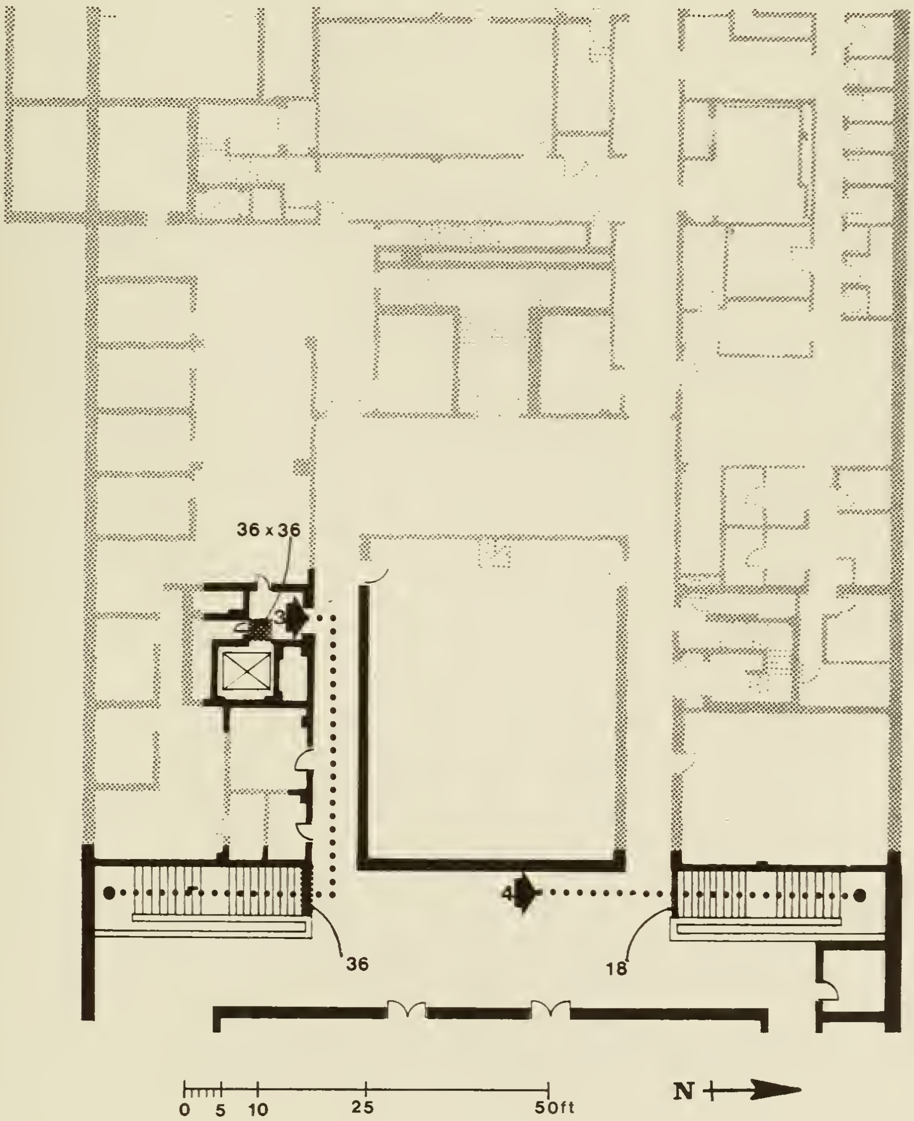



Figure 11.3: Newhouse 1 - Procedures 3 and 4

# Recommendations

# 7

## Recommendations

Following the completion of the final phase of field research, data and results of all phases and the workshop were analyzed, and design recommendations were formulated. These recommendations were then incorporated into the proposed ANSI A117.1 revision that was then reviewed by project staff, consultants and members of advisory review panels.[12] The recommendations listed below (indented), therefore, are based not only on conclusions reached in this study, but upon comments and suggestions of consultants and panel members as well. Commentary has been added here to further clarify several of the recommendations. Also, all these recommendations are not necessarily incorporated into the final ANSI Standard.

## Obstacles

> Objects that are potentially hazardous to people with severe impairments of vision shall either be detectable by the use of long cane techniques or removed from the path of travel.

It was concluded that dog guide users generally have fewer problems avoiding obstacles and traveling through irregular spaces than people who use canes. Therefore, environments designed to accommodate cane users would also be more barrier free to the larger population of visually impaired travelers. Recommendations made specifically to deal with obstacles and the visually impaired are as follows:

1. Site Furniture: If site furniture is built in as part of permanent construction, then it shall be located and designed to allow free passage and full use of site amenities.
2. Hazard Free Zone: No rigid, hard object shall project down into the space above a horizontal circulation path lower than 80 inches (2030 mm). No object shall project more than 4 inches (100 mm) from the side into the space above a horizontal circulation path, below this height.
3. Overhangs: If a piece of permanent built-in site furniture, such as a telephone enclosure, garbage receptacle, mail box, etc. is mounted on a wall, pylon or post and has an overhang above the detectable area of people who use long canes (see Fig. 12), then such overhangs shall be no greater than 12 inches (305 mm) in any direction from which a person may approach. Overhangs shall be measured from the face of the supporting structure at the ground to the vertical projection of the leading edge of the object onto the ground.
4. Boundaries of Hazardous Areas: If a hazardous area exists next to a walk or in pedestrian areas, a means shall be provided to help blind pedestrians avoid falling into the hazardous area (see Fig. 13).
5. Walk Surface Irregularities: Gratings located on walks shall have spaces no greater than 1/2 inch (12.5 mm) wide.

The maximum vertical displacement of surface changes shall be 1/4 inch (6.5 mm). Gratings should not be located in walks.

Warning Signals

Tactile warning signals shall be used to warn people with severe visual impairments of extreme hazards of falling or vehicular traffic hazards in a path of travel.

One of the major findings of the study was the usefulness of tactile floor warnings as cues to upcoming hazards. It was concluded in the design workshop that the warnings should be used only in situations where extreme hazards exist. The principle application of this recommendation is in situations where stairs lead down, directly in the path of travel, on transit vehicle loading platforms or on edges of streets having no curbs. Recommendations regarding the features of the warning signals are as follows.

Stairs in a Path of Travel and Passenger Loading Platforms:

Stairways should not be located directly in a path of travel. If stairs are located directly in a path of travel, then tactile warning signals shall be provided that meet the requirements for tactile warnings set forth below. These signals shall be provided at the top of stair runs and shall be located as shown in Fig. 14.[13]

Passenger loading platforms for public transit vehicles (e.g. subways and elevated trains) shall have tactile warning signals located along the entire edge of the platform not protected by guardrails or walls.

Tactile warning signals for stairs in a path of travel and for passenger loading platforms shall have the following features:

1. Configuration: Regularly spaced, continuous pattern of strips running parallel to the edge between a circulation path and a hazardous area.
2. Height and Spacing: As shown in Fig. 15.
3. Application: Grooves within a walking surface or applied surface area are preferred. If applied strips are used, then they should be fastened securely enough to eliminate the possibility of delamination (see Fig. 15).
4. Width, Perpendicular to Strips: 24 inches minimum if the material of the signal has a different perceived hardness than the material of the preceeding walking

surface; 36 inches (915 mm) minimum if the material of the signal cannot be perceived as a different hardness.

5. No other walking surface on a site or in a building shall have the same pattern as the warning signal.

Intersections of Pedestrian and Vehicular Circulation Paths:

If intersections of walks with streets or other boundaries between pedestrian and vehicular circulation areas are level and flush, then such boundaries shall have tactile warning signals and be clearly visible to operators of motor vehicles and bicyclists as well as pedestrians (see Fig 16).

In the absence of a formalized use of tactile warning signals, curbs and curb ramps can be used to warn of vehicular traffic hazards in the path of travel. The problem in this case, however, is complicated by the fact that curb ramp installations have been inconsistent and, therefore, have become a hazard in and of themselves. The most dangerous type of curb ramp for the visually impaired person is one that is installed at the apex of the curb (not within the crosswalk) and which directs pedestrians with severe impairments of vision towards the center of intersections (see Fig. 17).

Although a number of ideal situations were considered, they were ruled out primarily on the basis of high cost. However, two recommendations for installing curb ramps were developed. If they are consistently applied, the visually impaired traveler will be better able to cope with them. These recommendations are:

1. If marked street crossings are provided at intersections, then curb ramps shall be within the marked boundary (see Fig. 18A).
2. Ramps at the radius (or apex) of curbs shall have sides that are parallel to the direction of street crossings (see Fig. 18B).

Ramps in Buildings:

During the design workshop held following Phase 1, it was suggested that tactile floor warnings should be installed at the tops of ramps in buildings also. However, it was concluded that the slopes of ramps are natural cues and the ramps did not fall into the category of extreme falling hazards.

Handrails as Warning Signals:

Another staircase warning signal and mobility aid for the visually impaired is the handrail. The recommendations for handrails, applicable to the blind, are as follows:

1. Continuity: Continuous along both sides of stairs and

at least on one side of landings. The continuous handrail should be the inside handrail on parallel straight stairs and curved stairs. Continuous handrails on both sides of landings are preferred.

2. Extensions: Shall be at the top of stairways, at least 1 foot (305 mm) beyond top risers parallel with the floor surface; at the bottom of stairways, at least 1 foot (305 mm) beyond the bottom riser, parallel with the floor surface, starting at a point one tread width beyond the first bottom riser (see Fig. 19).

Doors to Hazardous Areas:

Door openers on doors to hazardous areas shall have tactile signals. These signals shall be a roughened surface on parts of the opener that come in contact with hands. The roughened surface may be a material applied to the opener but shall be standardized throughout a building or facility.

## Direction Finding Information

Tactile Characters:

Where information must be communicated to an individual to identify places such as floor or room numbers, raised or indented characters can be used.[14] To be legible to blind and partially sighted people, they shall have tne following characteristics:

1. Raised Characters: Raised off their background at least 1/32 inch (0.8 mm) and at least 5/8 inch (16 mm) high.[15]
2. Indented Characters: Indented at least 1/32 inch (0.8 mm) and with a strokewidth of at least 3/8 inch (10 mm).
3. Type of Character: A majority of people with severe visual impairments do not read braille; thus, raised characters should use the standard Roman or Arabic alphabet and numbers.[16]
4. Color: The color of characters and symbols shall contrast with their background. (It is preferred) that light colored characters or symbols should be used in combination with a dark background.
5. Mounting: A consistent mounting height and location simplifies finding characters.

Elevators:

A principle application of the above guidelines is in elevators. Specific recommendations as they relate to the blind user are as follows:

1. All elevator hoistway entrances shall have floor designations provided at both jambs. The centerline of characters shall be located 5 feet (1525 mm) from the floor. Such characters shall be raised and shall be a minimum of 2 inches (50 mm) high (see Fig. 20).
2. All elevator hoistway entrances shall have visual and audible signals to indicate an approaching car and its direction of travel...audible signals shall sound once for the up direction and twice for the down direction.
3. Elevator control panels shall have the following features:
   A. Location and size of controls: as shown in Fig. 20.
   B. Raised control designations: Arabic or Roman characters or standard symbols as shown in Fig. 20, located to the left of all controls.
   C. Main entry floor control: In left-most column, designated by a raised star at the left of the floor designation (see Fig. 20).
   D. Emergency controls: grouped together at the bottom of the panel (see Fig. 20).
   E. Controls not essential to automatic operation of elevator: located as convenient.

4. As the car passes or stops at a floor served by the elevator, an audible signal shall sound. If elevators in a building are zoned, then such signals shall operate only when the elevator is passing through the zone it serves. An automatic verbal annunciation of the floor number at which a car stops may be substituted for the above audible signal.

Room Numbers:

Another major application of the aforementioned guidelines is tactile characters for room identification. Minimum height and raise specifications mentioned above apply here also.

> If room numbers in buildings are raised or indented, they should be placed at a height of 60 inches (1525 mm) from the floor to the centerline of the characters.

Descriptive Material About Public Buildings:

> Signs with descriptive material about public buildings, monuments and objects of cultural interest should have tactile letters if audio tape devices or a sighted guide are not available to present the same information. If

provided, room identification signs and numbers should be raised. Tactile maps or auditory instructions should be available in building complexes where finding locations independently on a routine basis may be a necessity (e.g. college campuses).[17]

Visual Landmarks:

Visual landmarks that can easily be distinguished by partially sighted individuals should be used as orientation cues at the end of corridors. Such cues include changes in illumination level, bright color, unique pattern, wall murals, location of special equipment or other architectural features (e.g. an exterior view).

Information Aids:

The final recommendation regarding direction finding deals with information aids.

It was concluded that reliable information sources should be located immediately adjacent to main entrances of museums, libraries and transportation terminals to give directions or guide people who have severe visual impairments. This source may be a direct-line telephone, intercom or employee. The source should provide full information for use of the facility by the public.

Table 9: <u>Graphic Conventions</u>

| | |
|---|---|
| 54 / 1370 | Typical dimension line showing imperial units (in inches) above the line and metric units (in mm.) below. |
| 15 / 380 | Small dimensions indicated on extended line. |
| 39 54 / 990 1370 | Dimension line showing alternate dimensions required. |
| | Direction of approach. |

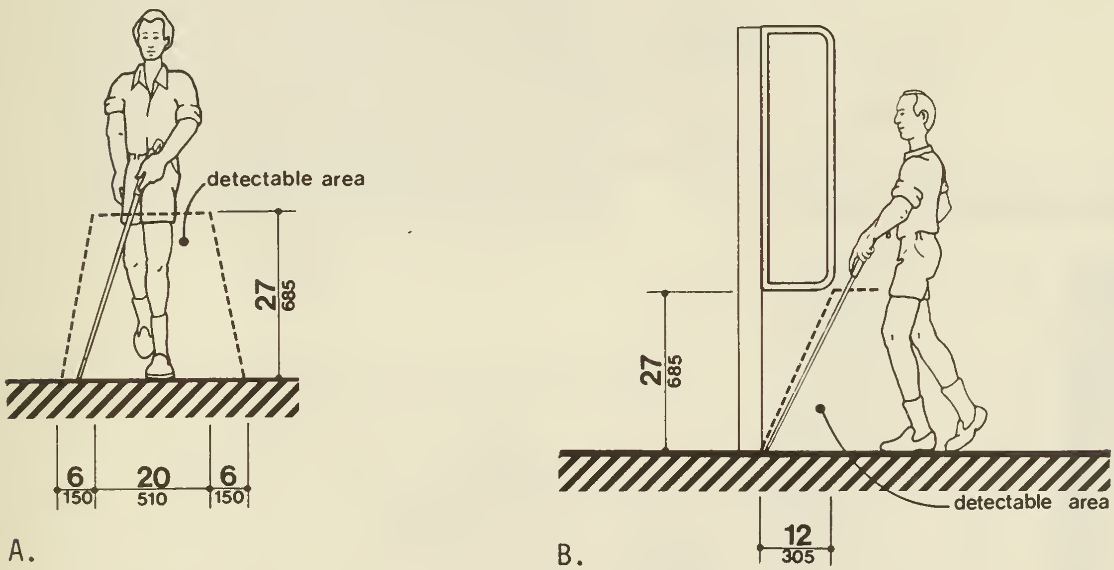
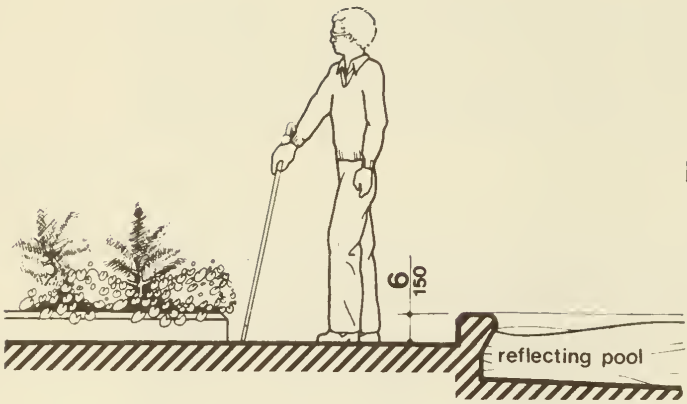



Figure 12: The Detectable Area of People Who Use Long Canes (27 inch height based on small person)




Note: Other methods, such as railings or bollards can be used to define boundaries.

Figure 13: Example of Boundary Curb at Hazardous Area

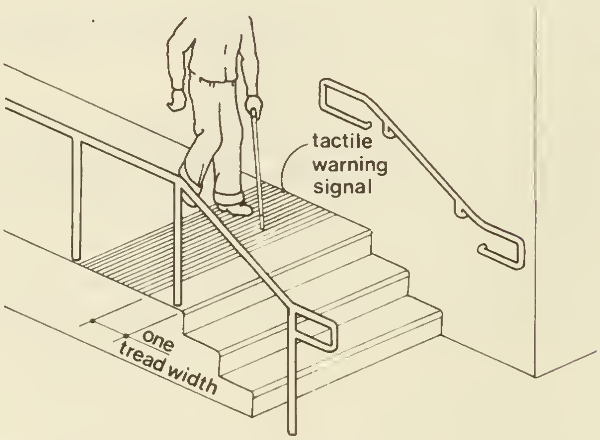
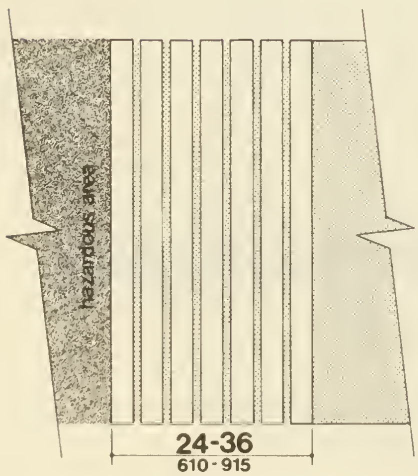



Figure 14: Tactile Warning Signal at Stairs Leading Down



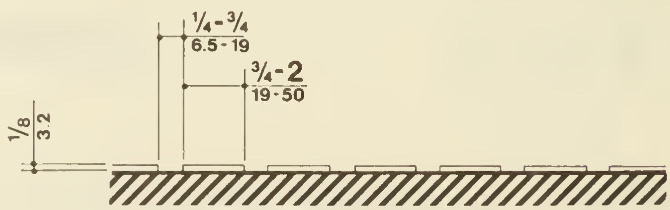
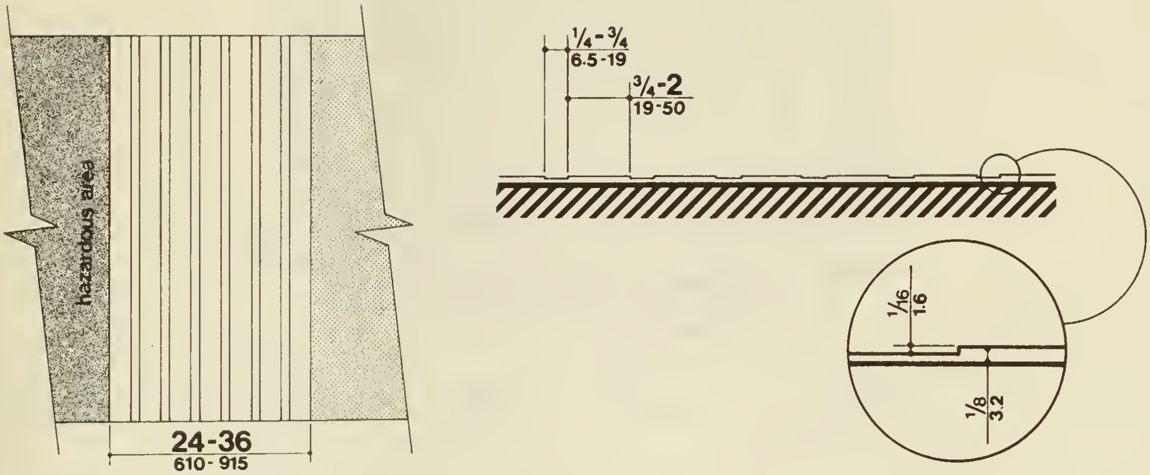



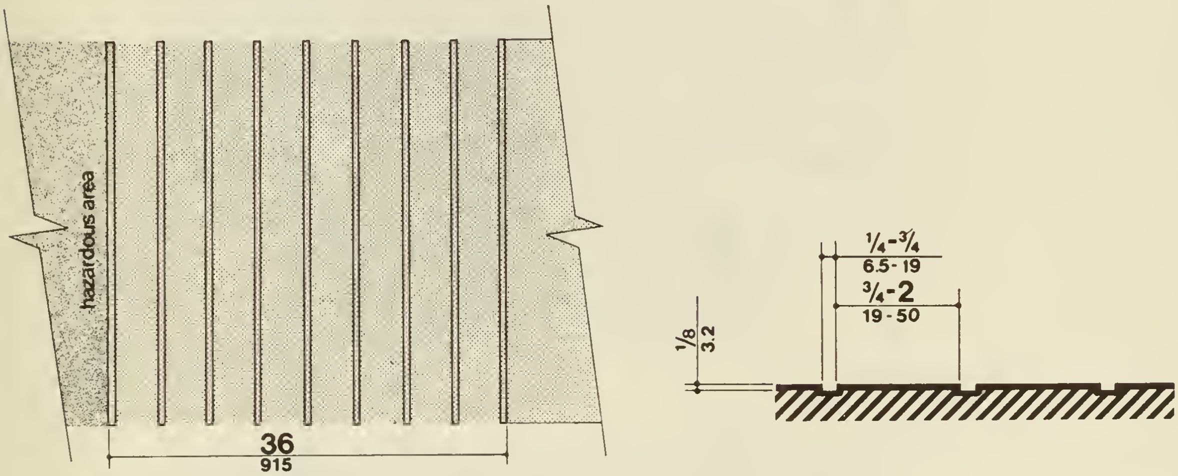

Figure 15.A: Strips Applied on Base Material

Figure 15: Tactile Warning Signals on Floor or Ground Surfaces




Plan Section

Figure 15.B: Applied Surface Area




Plan Section

Figure 15.C: Grooves in Base Material

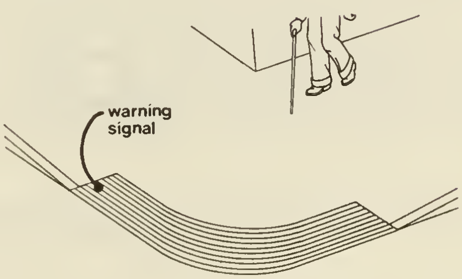



Figure 16: Example of Warning Signal at Boundary Between Walk and Street

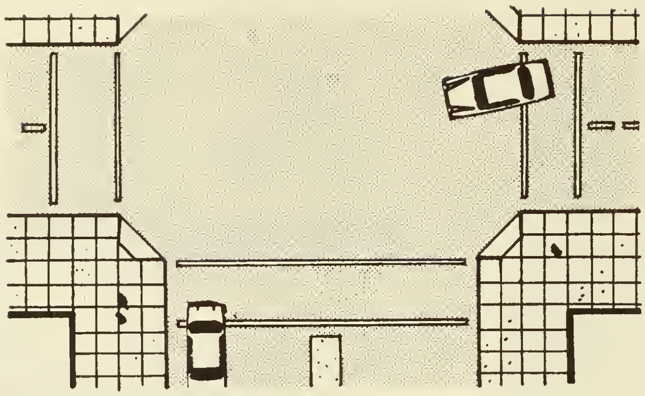


Figure 17: Example of Dangerous Placement of Curb Ramps

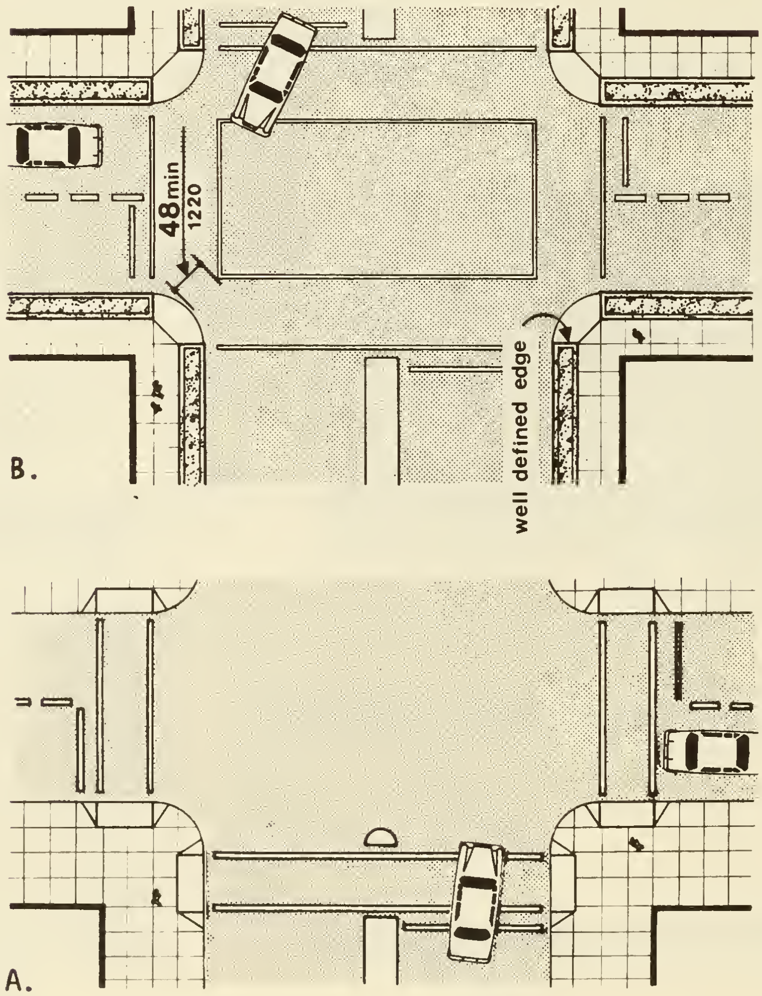
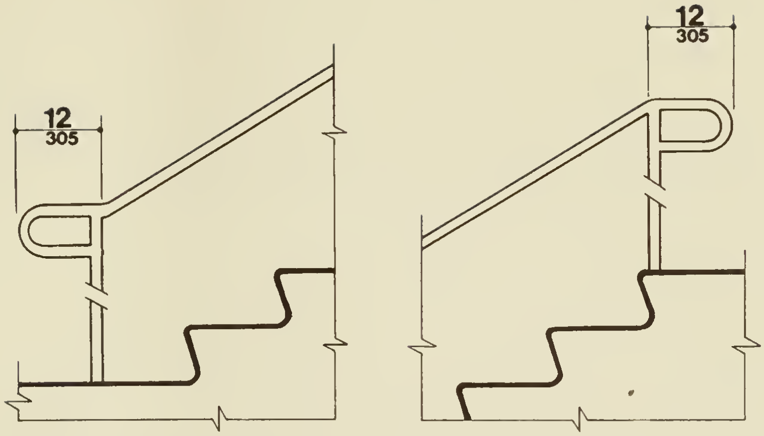



Figure 18: Recommended Placement of Curb Ramps




A. Bottom of Run B. Top of Run

Figure 19: Examples of Handrail Extensions

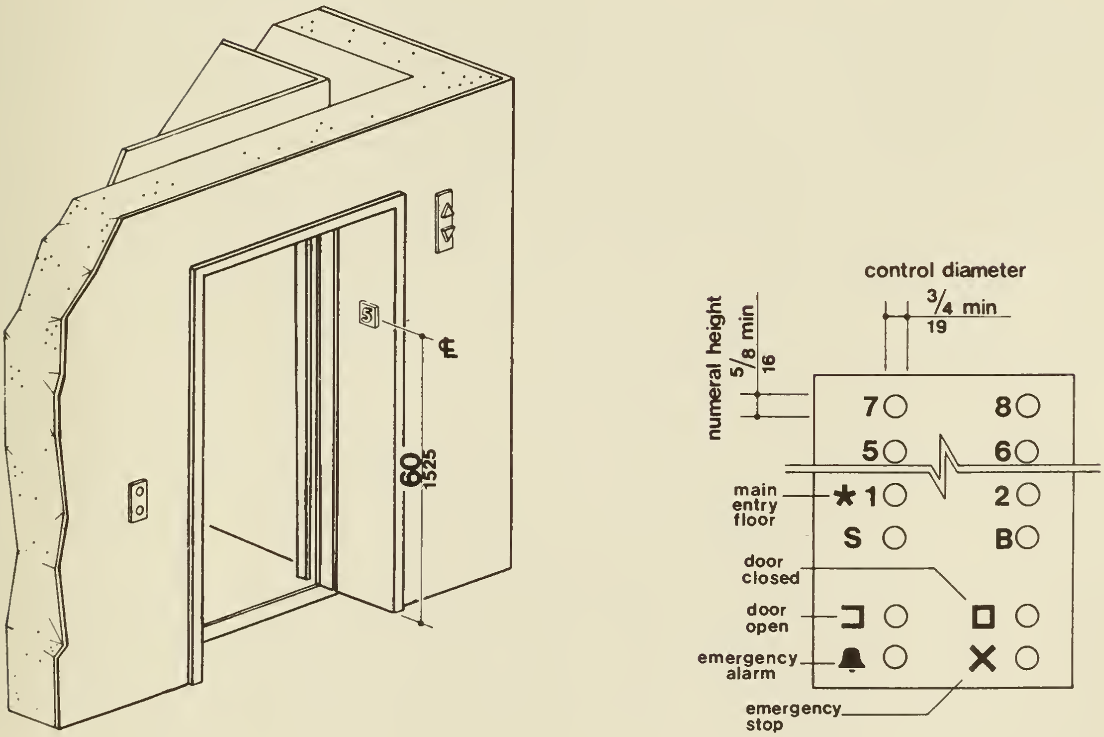
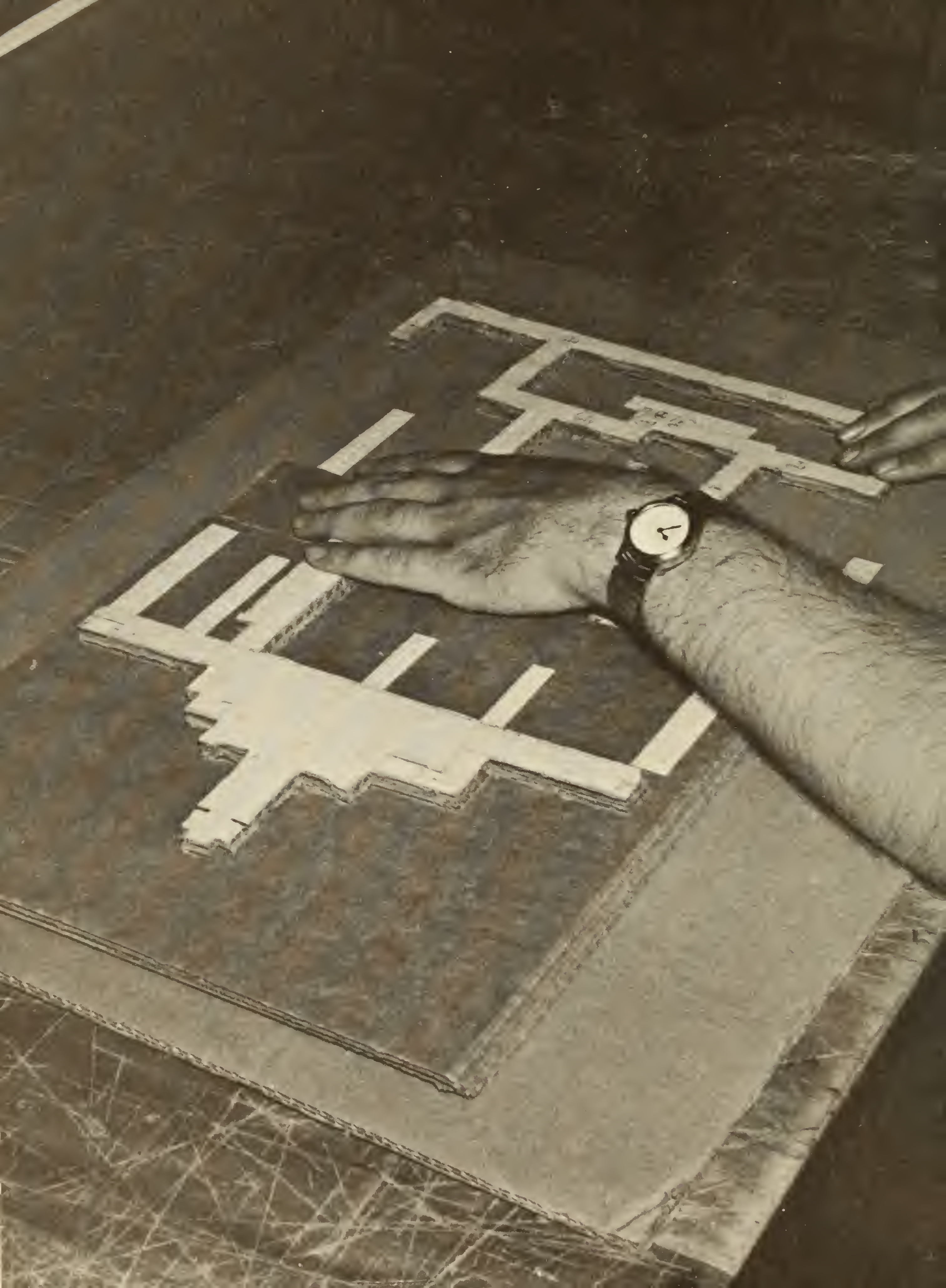



Figure 20: Floor Designations at Elevator Hoistway Entrance and Elevator Control Panel

# 8

# Summary



## Summary of the Study and Implications for Future Research

The focus of this study was to: 1) investigate the types of orientation and mobility problems visually impaired individuals encounter in architectural settings and 2) propose and test design solutions to help alleviate these problems. In addition, an investigation into building imageability as it affects orientation and mobility was initiated. The main objective of the study was the formulation of recommendations for inclusion in the revised ANSI A117.1 Standard.

A combination of field research, expert brainstorming and laboratory research were used in the study which was completed in three phases. Phase 1 of the research dealt primarily with problem identification. Following this phase, a design workshop was held to analyze the data, brainstorm possible solutions to mobility problems and ascertain areas requiring further research.

Phase 2 of the research was conducted in a laboratory which was designed to test out proposed methods for warning visually impaired individuals of upcoming falling hazards. After the data were analyzed, a method of using tactile floor signals was devised and then tested during Phase 3 in a real architectural setting.

Following the completion of the final phase of field research, data and results were analyzed and several design recommendations were formulated. The major areas covered by these recommendations were: 1) elimination of potentially hazardous objects in or near a path of travel, 2) tactile signals to warn of upcoming falling hazards, and 3) aids and information helpful in direction finding and orientation.

As an exploration of the imageability of buildings, this effort has raised more questions than it has answered, especially in regard to how imageability affects the orientation and mobility of blind travelers. The objectives of further work in this area should be to: 1) identify criteria for the design of circulation spaces that can help make the built environment more accessible to the visually impaired traveler, 2) to provide information for those interested in improving orientation and mobility instruction for the blind, 3) generate data necessary in the construction of orientation and mobility aids (tactile and audio maps) for the blind, and 4) contribute to the general theory of direction-finding and orientation.

Notes

1. Note that statistics on visual impairments are estimated because of reporting inconsistencies. These inconsistencies are due primarily to the fact that different definitions for blindness are used throughout the U.S.

2. The disk was 4 5/8 inches in diameter, had a 1 1/2 inch rotating pointer and was divided into 16 segments; each segment coincided with one of the 16 steps of a demonstration route. Each segment contained braille information about each step, plus directions needed to get to the next step of the route. The pointer was used to keep track of where the traveler was along the route.

3. It was decided to work with cane travelers only, because it was felt that they were the critical group for design. Dog guide users have less of a problem with falling hazards than cane travelers, and dogs could easily be trained to use additional cues. With regard to partially sighted persons who travel visually, careful thought about color contrasts is important, and findings from previous research in this area are available.

4. When formulating the directions, we tried to make sure that we did not present the participants with too much detail, thus invalidating our procedures. Our aim was to give realistic directions; i.e. those that might be given by a passer-by that is asked directions by a blind traveler. In order to obtain directions, we posed a scenario to a number of individuals encountered along the Slocum-Link route. We asked them what their directions would be to help a blind traveler to get from point to point along the route. After obtaining a number of different sets of directions, they were combined and reviewed by our orientation and mobility consultants, revised into a final form and recorded.

5. Participants at the workshop included: 1) from Syracuse University Architecture Research Office - Edward Steinfeld, Project Director, Rolf Faste and Steven Schroeder, Research Associates, James Aiello, Research Assistant, and Bill Sherrow, Special Consultant; 2) from Lighthouse of Onondaga County - Dan McLaughlin and Hannalare Ketterer, Mobility Specialists; 3) Eunice Fiorito, Director of the Mayor's Office for the Handicapped, New York City.

6. Note that <u>all</u> of the data collected during Phase 1 was utilized in the discussions, with special emphasis being placed on data gathered during the post-walk interview -- specifically, problem identifications and design suggestions that were solicited from the participants.

7. An average traveler was defined as a person who encountered between three to fifteen environmental problems during the Phase 1 walk; i.e. within one standard deviation around the mean of 8.6 problems. Twelve people met the selection criteria and a subgroup of ten, plus two substitutes, was planned. However, four could not participate. See

Footnote 2 for rationale behind using cane travelers only.

8. Some participants felt that they missed the 16 or 18 inch cues because of the way the materials were placed on the floor (see Fig. 5 and 6). They felt that if the material had been applied consistently across the entire 16 or 18 inches, then they would not have missed them.

9. In his study (1976a), Mr. Archea is thoroughly researching stairway problems and stairway design.

10. Our project did not test warning signals at walk/street intersections or on subway platforms, so as not to overlap research and testing of other individuals. The problem of tactile signals at intersections of walks and streets is being investigated by John Templer of Georgia Tech University and the reader is referred to that study's report for information regarding his findings. Testing of warning signals on subway platforms is being conducted by the New York City Public Transit Authority (1976). They have installed a warning signal at the underground station at 49th St. and 7th Ave. in Manhattan. Their signal is an orange strip, 10 inches wide, installed 20 inches from the edge of the platform and running the entire length of the platform. The material is an all epoxy base that encapsulates special heavy-duty granules, which protrude above the surface of the base to create a change in surface. Reports from visually impaired persons who use this station indicate that the material is successful; not only as a warning signal, but as an orientation cue as well. Observations have also shown that the majority of sighted users stood behind this strip while waiting -- thus, adding an additional positive safety factor to the use of the signal.

11. Several participants were also video taped during Procedure 1, so that further analysis could be made regarding their use of the tactile floor signals.

12. The proposed revisions to ANSI A117.1 were reviewed several times by an advisory panel of 120 consumers, consumer advocates, building industry spokesmen, representatives of government agencies, design professionals and therapists. Drafts were sent to the panel members and a series of meetings were held with each special interest group.

13. By placing the signal one tread width back from the first step of the staircase, the warning signal doesn't distract the visual attention to the floor when people should be looking at the staircase, thus creating a hazard for sighted people. It also seems to be the consensus that this placement enhances the usefulness of the signal for both sighted and visually impaired people.

14. Raised characters are easier to feel at small sizes and are not susceptible to maintenance problems as are indented characters which can fill or be filled with dirt, gum, cleaning compounds, etc.

15. While it is possible to read a character raised 1/64 inch (braille is raised 0.001 in) it was concluded that readability would be enhanced if the raise were 1/32 inch, especially for the large number of blind individuals who suffer from a loss of the sense of touch, e.g. the diabetic blind and the elderly.

16. Although the actual percentages vary from source to source, it is generally felt that between 10 and 15 percent of the blind use braille functionally. Therefore, it was felt that raised Roman and Arabic characters were more applicable than braille characters in most cases. This recommendation does not preclude the use of raised brailled characters where applicable. However, in these cases, both braille and Arabic or Roman characters should be provided.

17. Past research shows that the use of tactile descriptions and maps are used only sparingly by the blind, and when they are, they are used by a very small subgroup of the blind population. Audio descriptions and maps are highly preferable to tactile devices.

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## Glossary

adventitiously blind: those who have lost their sight at some point after the age of five.

congenitally blind: those born blind, or those who have lost their vision before the age of five. (It has been found that individuals who have lost their sight prior to age five function like those born without sight.) (McLaughlin, 1977)

dog guide: the use of a trained dog as a mobility aid.

imageability: "That quality in a physical object which gives it a high probability of evoking a strong image in any given observer." (Lynch, 1960, p 9)

independent traveler: one who can negotiate most familiar and unfamiliar routes independently.

information point: a familiar object, sound, odor, temperature or tactual cue whose location in the environment is known but is less apt to be recognized or perceived than a landmark, e.g. a water fountain motor (McLaughlin, 1977).

landmark: any familiar object, sound, odor, temperature or tactual cue having a known and exact location in the environment and which is readily and consistently recognized (McLaughlin, 1977).

legally blind: a definition used to determine elegibility for public assistance; if an individual's "...central visual acuity does not exceed 20/200 in the better eye with correcting lenses, or if one's visual field is less than an angle of 20 degrees." (American Foundation for the Blind, Inc., 1975, p 3)

legibility: "The ease with which (an environment or)...its parts can be recognized and can be organized into a coherent pattern." (Lynch, 1960, p 2)

long cane: instrument designed as an extension of the touch sense and as a means of protection. It is used as a mobility aid by the majority of visually impaired travelers. The two principle cane techniques consist of the touch technique, where the cane is held at the midline in front of the body, and arcs from side-to-side touching points outside both shoulders; and the diagonal technique where the cane is held in a stationary position diagonally across the body with the cane tip touching, or just above the ground at a point outside the left shoulder, and the handle or grip extending to a point outside the right shoulder (reverse for left-handed individuals). The diagonal technique is used primarily in certain limited, controlled and familiar environments, while the touch technique is used primarily in uncontrolled environments. Cane users are often trained in the use of both techniques (McLaughlin, 1977).

mobility: "The physical process of skillfully navigating from a present fixed position to a desired position in another part of the environment", in a systematic and safe manner (Wiener, 1970, p 1).

orientation: "The mental process of understanding the environment from past experiences with it, learning new information about the environment from sensory cues, and organizing both forms of information in such a way that, "...1) moment-to-moment relationships to the immediate environment can be maintained (near orientation) and 2) routes of travel from one point to another point can be effectively planned (far orientation)." (Wiener, 1970, p 1 and Leonard, 1972, p 40)

orientation and mobility specialist: "Person responsible for teaching...(visually impaired)...individuals those techniques which have proven effective in increasing the travel capabilities of the visually disabled." (Wiener, 1970, p 5)

partial blindness: those visual impairments where some usable vision is present; that is, where some degree of light, color or object perception, or any combination of the three is present. Seventy-five percent of those with severe visual impairments have some usable vision (American Foundation for the Blind, Inc., 1975, p 3).

rote traveler: one who cannot negotiate unfamiliar routes without first being repeatedly guided over each route in order to become familiar with it.

sensory cues: any sound, odor, temperature or tactual stimulus affecting the senses, and that can be readily converted in determining one's postion or line of travel (McLaughlin, 1977).

severe visual impairment: those that are classified as legally blind.

sight disabilities: partial or full loss of sight to the extent that an individual's ability to perform various functions, such as reading graphic material or traveling independently in public places is limited.

total blindness: total loss of sight.

trailing: a mobility technique where the hand (or cane) is used to follow shorelines (edges formed where two surfaces meet), walls or hedges. It is used to detect familiar landmarks, determine a sense of direction and ensure movement in a parallel line (Murphy, 1975, p 12).

visual impairment: a general term referring to partial or full loss of sight.

visual traveler: those individuals who have enough usable or residual vision that they do not have to totally rely on the standard mobility aids (such as cane, dog guide or electronic aids) in their travels.

Appendix A: Background Questionnaire

The first two sections of the questionnaire were designed to provide background information on each participant. It was also felt that questions such as those presented in Sections 1 and 2 were necessary to establish a good rapport between client and questioner so that the former would not feel ill-at-ease when Section 3 was presented. Aggregate data regarding blindness, and orientation and mobility training (Section 2) are presented in the section of the report dealing with Phase 1 results.

Section 3 was designed to provide attitudinal information: Part 1 measures self-esteem, and Part 2 gives some indication of level of motivation and achievement. The data gathered in this section were to be used to help categorize individuals into subgroups for testing in Phases 2 and 3 of the project. Our hypothesis was that levels of self-esteem and of motivation and achievement correlated highly with traveling ability; that is, highly motivated individuals or those with high levels of self-esteem would be better travelers than those with lower levels. If this hypothesis were correct, then an individual's performance in the field could be predicted by his or her scores in this section.

The questions used in Part 1 (self-esteem) are adaptations of those used by James Diggory (1966). Only one of the consumer testers had difficulty with these questions and could not complete this part of the questionnaire. After each of the participants completed the questionnaire their average level of self-esteem was calculated, and after all 28 persons completed it, a group mean (74 percent) and standard deviation (12.4 percent) were calculated. Individuals were then categorized by level of self-esteem. The scores of 19 individuals fell within one standard deviation of the mean (61.6 through 86.4 percent) and they were said to have an "average" level of self-esteem. The five persons with scores higher than 86.4 percent were classified in the "high" self-esteem group, the three with scores lower than 61.6 percent were put in the "low" self-esteem group.

As was mentioned earlier, the second part of Section 3 deals with motivation and achievement. In order to quantify these concepts, a number of activities, suggested by Carroll (1961) as being important in the restoration and rehabilitation of an adventitiously blinded individual's well being, were given scores ranging from one to four to indicate level of difficulty. Activities dealing primarily with independence of travel were scored by orientation and mobility specialists and those dealing primarily with rehabilitation problems were graded by rehabilitation specialists. Activities dealing with travel and rehabilitation were scored by both types of specialists. The score assigned each activity was the average of the scores assigned by the specialists.

After each participant completed the questionnaire, a weighted participation score was calculated, i.e. the sum of the assigned levels of difficulty for each activity multiplied by the number of times in the previous week the activity was performed. The group mean (113.6) and

and standard deviation (48.9) were then computed and categories reflecting "average", "high" and "low" levels of motivation (using level of activity as a surrogate) were formed. The highly motivated group was composed of five individuals with scores higher than 160.8; average by 19, with scores ranging from 64.4 to 160.8; and low by four, with scores lower than 64.4.

Finally, the data indicate that in this case, the hypothesis regarding the correlation between levels of self-esteem and motivation and performance in the field (measured by the number of environmental problems encountered during the walk) was incorrect. In the case of self-esteem versus performance, R = 0.046; in the case of motivation versus performance, R = 0.127. It was concluded, therefore, that levels of self-esteem and motivation could not be used to predict one's level of traveling ability in this study.

BACKGROUND QUESTIONNAIRE

*This column is for computer coding purposes.

Subject ID______________________ A 1-2____________

Section 1: Demographic and Physical Environment Information

1. Do you live in an urban (1), suburban (2) or rural (3) area? 3____________

2. What type of structure do you live in?
   one or two family house (1)
   garden apartment (2)
   medium-rise apartment (3)
   high-rise apartment (4)
   institution (5) 4____________

3. Approximately how long have you lived at your present place of residence?__________ 5-8____________

4. How many years of education have you had?_________ 9-12____________

5. Have you ever attended a school for the blind?
   no (0) yes (1) 13____________
   years___________ 14-17____________

6. Have you ever attended a public or parochial school (includes elementary, junior high, high school, college or technical school)?
   no (0) yes (1) 18____________
   years___________ 19-22____________

7. Have you ever attended any other private schools except a school for the blind or college?
   no (0) yes (1) 23____________
   years___________ 24-27____________

8. Are you presently employed? no (0) yes (1) 28____________

   If unemployed, SKIP TO SECTION 2

9. What is your occupation?______________________________ 29-30____________

10. Is your place of work in an urban (1), suburban (2), or rural (3) area? 31__________

11. Is your place of work in a public building?
    no (0) yes (1) 32__________

    If no, what type of building is your place of work?
    ____________________ 33__________

Section 2: Blindness and O&M Instruction Information

1. Age______ 34-35__________

2. At what age did blindness occur? 36-37__________

    Length of time afflicted (1 minus 2) 38-39__________

3. Are you totally (1), or partially (2) blind? 40__________

    If blindness is total, SKIP TO QUESTION #10

4. Is the condition stable? no (0) yes (1) 41__________

5. Are both eyes involved? no (0) yes (1) 42__________

6. Do you have:
    a. tunnel vision no (0) yes (1) 43__________
    b. peripheral vision no (0) yes (1) 44__________

7. Can you see:

| | No | Yes | If yes, approximately how far away? | |
|---|---|---|---|---|
| a. non-moving objects or features? | (0) | (1) | ________ | 45________ |
| b. moving objects or features? | (0) | (1) | ________ | 46________ |
| c. light? | (0) | (1) | ________ | 47________ |
| d. color? | (0) | (1) | ________ | 48________ |
| e. ordinary newsprint without low-vision aid? | (0) | (1) | ________ | 49________ |
| f. ordinary newsprint with low-vision aid? | (0) | (1) | ________ | 50________ |

8. Are you able to see a TV screen? no (0) yes (1) 51__________

    If yes, approximately how far away from the screen do you sit?________

9. Do you use low-vision corrective lenses? no (0) yes (1) 52__________

    If yes, when?________________

    If yes, what type of lenses do you use? (i.e. glasses for distance, reading, bifocals, magnifying lenses, protective, etc.)________________

10. Can you read braille? no (0) yes (1) 53__________

    If yes, at what level (grade) do you read? (1 or 2) 54__________

11. Can you write braille? no (0) yes (1) 55__________

    If yes, at what level (grade) do you write? (1 or 2) 56__________

12. Do you have any other impairments or chronic conditions?
    no (0) yes (1) 57______

    If yes, what kind and to what degree?______
    ______ 58-59______

Subject ID______ 1-2______

13. O&M information:

    a. How much formal O&M training have you had?______ 3-6______
    b. What type of formal training did you have?______ 7-8______
    c. What was the time lapse between affliction and instruction?______ 9-12______
    d. General evaluation scores (if narrative, code as zero and attach copy).
       1. Orientation:
          a. use of senses______ 13______
          b. understanding of concepts related to O&M______ 14______
          c. organization of environment through mental mapping______ 15______

       2. Mobility skills/kinesiatric evaluation______ 16______
    e. Are you a rote (1) or risk (2) traveller? 17______
    f. Do you normally travel with a long cane? no (0) yes (1) 18______
    g. Do you use any other type of O&M aid? no (0) yes (1) 19______

       If yes, what aid(s)?______ 20-21______
    h. O&M instructor______
    i. Time O&M instructor had in field at time of instruction
       ______.

Section 3: Attitudinal Information

Part 1: Self-Esteem

1. When doing things that interest you most, in what percent of such cases are you fully satisfied with your performance? ______% 22-24______

2. When you participate in group activities that call for decisions to be made, in what percent of such cases do your ideas and opinions influence the general decision? ______% 25-27______

3. When a situation demands that you take initiative and act independently, in what percent of such cases can you handle things on your own? ______% 28-30______

4. When meeting new people for the first time in social, business or academic settings, in what percent of such cases are you able to impress them favorably and form good relations? ______% 31-33______

5. When others trust and depend on you to carry out a certain job for them, in what percent of such cases do you behave dependably? ______% 34-36______

6. When sound judgment is needed about the appropriate actions to be taken in special situations, in what percent of such cases do you make sound judgments? ______% 37-39______

7. When you face new situations which require rapid and accurate problem-solving ability, in what percent of such cases are your solutions rapid and accurate? __________% 40-42__________

8. When you try to reach important goals of any kind, in what percent of such cases do you feel you have really succeeded? __________% 43-45__________

Part 2: Motivation & Achievement

1. Do you live:
   - alone (1)
   - with family (2)
   - with roommates (3)
   - other (4) explain____________________ 46__________

2. How do you normally travel when you leave your home?
   - alone (1)
   - with other blind individuals only (2)
   - with sighted individuals only (3)
   - with a mixed group of blind and sighted individuals (4) 47__________

3. When travelling from your home, which type of transportation do you use most often (rank as 1)? Next most often (rank as 2)? What type of transportation do you use the least (rank as 4)?
   - walk ( ) 48__________
   - bus ( ) 49__________
   - car ( ) 50__________
   - taxi ( ) 51__________

4. What is the farthest that you have ever travelled independently since your visual impairment (approximate mileage or name of place)?____________________ 52-55__________
   a. What type of transportation did you use?
      - walk (1) train (5)
      - bus (2) plane (6)
      - car (3) ship (7)
      - taxi (4) 56__________
   b. What was the reason for the trip?____________________
      ____________________ 57-58__________

5. Are you able to travel new routes independently?
   no (0) yes (1) 59__________

6. Do you find it easy to ask directions from strangers?
   no (0) yes (1) 60__________

7. How often do you associate with other blind individuals?
   - never (0)
   - some of the time (1)
   - most of the time (2)
   - all of the time (3) 61__________

8. Do you have close friends who are not blind?
   no (0) yes (1) 62__________
   If yes, do you do a lot of things with them?
   no (0) yes (1) 63__________
   If yes, what do you do with them?____________
   ____________________ 64-65__________

Subject ID________________________ C 1-2__________

9. This question concerns your participation in a number of activities. After I name each activity, I want you to tell me if you've ever participated in it after you were visually impaired. If you have, I'd like to know how many times you've done it in the last week. Finally, if you haven't participated in the activity, do you think you might in the future?

| Activity | Have Done | Times In Past Week | Might Do |
|---|---|---|---|
| (1.0) | | | |
| Listen to radio or records | | | |
| Watch TV | | | |
| Participate in group discussions | | | |
| (1.5) | | | |
| Have a hobby or collect anything | | | |
| Attend church | | | |
| (2.0) | | | |
| Play checkers | | | |
| Wash clothes | | | |
| Iron | | | |
| (2.5) | | | |
| Write by hand | | | |
| Clean house | | | |
| Do home repairs | | | |
| Cook | | | |
| Dance | | | |
| (3.0) | | | |
| Read | | | |
| Play cards | | | |
| Play a musical instrument | | | |
| Sew or knit | | | |
| Take walks | | | |
| Hike | | | |
| Camp out | | | |
| Swim | | | |
| Grocery shop | | | |
| (3.5) | | | |
| Visit friends & relatives | | | |
| Eat out | | | |
| Go on picnics | | | |
| Leave your home alone | | | |
| Travel alone in public buildings | | | |
| Fish | | | |
| Ride horse back | | | |
| Canoe or row | | | |
| Shop for clothes and household goods | | | |
| Go to school | | | |
| Work | | | |

9. continued....

| Activity | Have Done | Times In Past Week | Might Do |
|---|---|---|---|
| (4.0) | | | |
| Attend plays & movies | | | |
| Attend lectures | | | |
| Attend concerts | | | |
| Attend sporting events | | | |
| Visit museums | | | |
| Window shop | | | |
| Travel on vacation | | | |
| Play golf | | | |
| Bowl | | | |
| Water ski | | | |
| Skin dive | | | |
| Snow ski | | | |
| Compete in any sporting event such as track & field or running | | | |
| Coach athletic teams | | | |

Have done 3-4______________

Weighted participation score 5-8______________

Might do 9-10______________

10. Are you satisfied with your past achievements? no ( )
( ) yes 32______________
If no, why not?______________________________________
______________________________________________
______________________________________________

11. What are your life goals?______________________________
______________________________________________
______________________________________________
______________________________________________

Appendix B: Post-Walk Questionnaire

1. Subject ID ______________

2. Were the directions easy to follow? no ( ) yes ( )
   If no, why not?

3. Were the directions detailed enough to give you an adequate amount of help in negotiating the route? no ( ) yes ( )
   If no, why not?

4. Do you have any suggestions as to how the directions might be improved to aid you in better negotiating this particular route?
   no ( ) yes ( )
   If yes, list each separately, continually probing until all responses have been exhausted.

5. Was the route difficult (1) or easy (2)? _____

6. Can you think of any particular area or areas that gave you a lot of trouble? no ( ) yes ( )
   If yes, repeat each of the following for each problem area:
   a. Please describe the area.
   b. Is there any particular reason why you had problems in this area?
   c. Do you normally have difficulties in situations such as this in any building that you enter?
   d. What do you suggest might be done to help alleviate this problem?

7. The following questions deal with the problem areas that were noted during the walk by the observer, but not mentioned by the consumer tester in Question 6. They should be repeated for each problem area noted.
   a. I noticed that you had some difficulty in negotiating ____________. Is there any particular reason why you had problems in this area?
   b. Do you normally have difficulties in situations such as this in any building that you enter?
   c. What do you suggest might be done to help alleviate this problem?

8. Did you have any particular problem or problems in negotiating the staircase? no ( ) yes ( )
   If yes, list each separately and ask the following for each problem, continually probing until all responses have been exhausted.
   a. Do you normally have difficulties such as this when you encounter a staircase? no ( ) yes ( )
   b. What do you suggest might be done to alleviate this problem?

9. Did you notice the ramp? no ( ) yes ( )
   If yes, did you have any particular problem or problems negotiating it? no ( ) yes ( )
   If yes, list each separately and ask the following for each problem, continually probing until all responses have been exhausted.
   a. Do you normally have difficulties such as this when you encounter a ramp? no ( ) yes ( )
   b. What do you suggest might be done to help alleviate this problem?

10. Landmark and Information Point Recognition:

    A. Auditory: Did you notice any outstanding sounds or noises during the walk? no ( ) yes ( )
    If yes, list each separately and ask the following for each one, continually probing until all responses have been exhausted.
    a. Can you identify the sound or noise? no ( ) yes ( )
    b. If yes, what was it? __________
    c. Can you locate this sound or noise in any particular area in the walk? no ( ) yes ( )
    d. If yes, where? __________
    e. Did this sound or noise help you in negotiating the route? no ( ) yes ( )
    f. If no, do you think it might if you were to walk the route again? no ( ) yes ( )

    B. Tactile: Did you notice any change in floor surface during the walk? no ( ) yes ( )
    If yes, list each separately and ask the following for each one, continually probing until all responses have been exhausted.
    a. Can you describe the change? no ( ) yes ( )
    b. If yes, please describe it. __________
    c. Can you locate this change in floor surface in any particular area in the walk? no ( ) yes ( )
    d. If yes, where? __________
    e. Did this change in floor surface help you in negotiating the route? no ( ) yes ( )
    f. If no, do you think it might if you were to walk the route again? no ( ) yes ( )

    C. Thermal: Did you notice any change in air temperature or air currents during the walk? no ( ) yes ( )
    If yes, list each separately and ask the following for each one, continually probing until all responses have been exhausted.
    a. Can you describe the change? no ( ) yes ( )
    b. If yes, please describe it. __________
    c. Can you locate this change in any particular area in the walk? no ( ) yes ( )
    d. If yes, where? __________
    e. Did this change help you in negotiating the route? no ( ) yes ( )
    f. If no, do you think it might if you were to walk the route again? no ( ) yes ( )

D. Olfactory: Did you notice any strong odors during the walk? no ( ) yes ( )

If yes, list each separately and ask the following for each one, continually probing until all responses have been exhausted.

a. Can you describe the odor? no ( ) yes ( )
b. If yes, please describe it. __________
c. Can you locate this odor in any particular area in the walk? no ( ) yes ( )
d. If yes, where? __________
e. Did this odor help you in negotiating the route? no ( ) yes ( )
f. If no, do you think it might if you were to walk the route again? no ( ) yes ( )

E. For Partially Sighted Only (visual):

1. Did you notice any changes in the level of lighting during the walk? no ( ) yes ( )
2. Did you notice any changes in the color scheme during the walk? no ( ) yes ( )

If yes, to number 1 and/or 2, list each response separately and ask the following for each one, continually probing until all responses have been exhausted.

a. Can you describe the change? no ( ) yes ( )
b. If yes, please describe it. __________
c. Can you locate this change in any particular area in the walk? no ( ) yes ( )
d. If yes, where? __________
e. Did this change help you in negotiating the walk? no ( ) yes ( )
f. If no, do you think it might if you were to walk the route again? no ( ) yes ( )

11. Do you have any general or specific suggestions to make that you haven't mentioned that might help us in designing the route so that you can negotiate it better? no ( ) yes ( )
If yes, please elaborate, and do you think that changes such as this would give you more confidence when you must walk routes in unfamiliar public buildings? (Continue probing for additional suggestions until responses have been exhausted.)

12. Do you have any special gripes about the way buildings are designed?

13. I am going to name some building types and I want you to tell me if you have any gripes about each type of building.
    a. airports, bus stations and train stations
    b. department stores and supermarkets
    c. museums
    d. concert halls
    e. houses
    f. apartment buildings
    g. school buildings

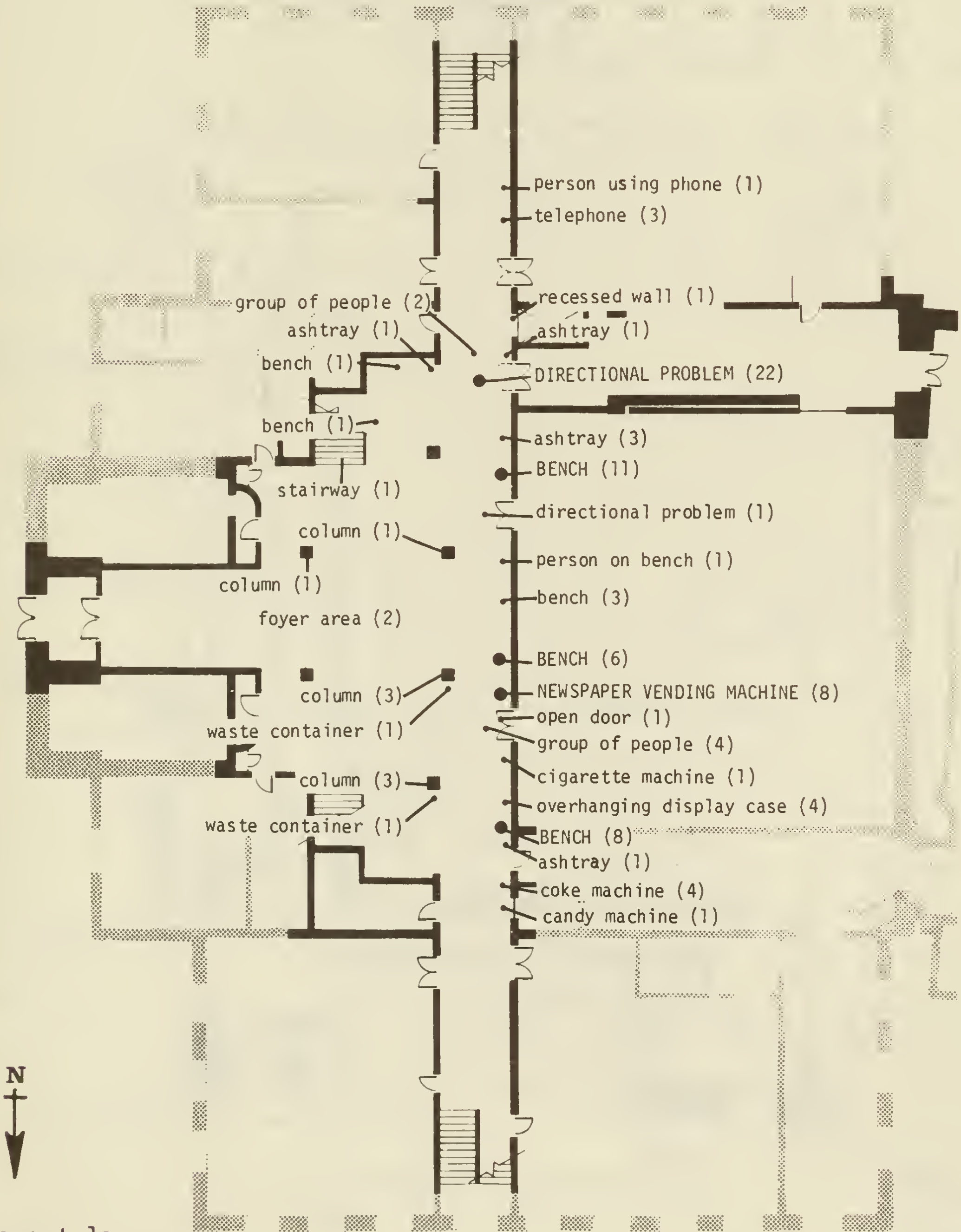
h. government buildings like city halls, court houses and post offices
i. hotels
j. any others?

14. Do you have any additional comments about your visit here, the questionnaires, the route, myself or anything else regarding the project and what it is trying to accomplish?
    If yes, please elaborate.

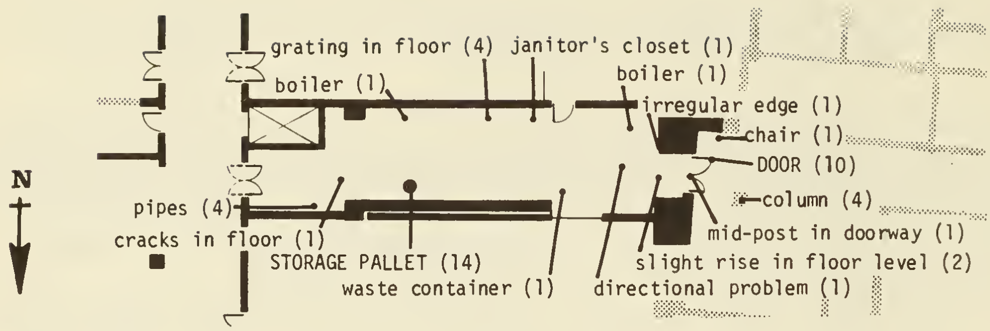
15. Would you consent to visit with us again in the future if we should need your help? no ( ) yes ( )

## Appendix C: Directional and Environmental Problems Encountered During the Phase 1 Walk -- By Segment

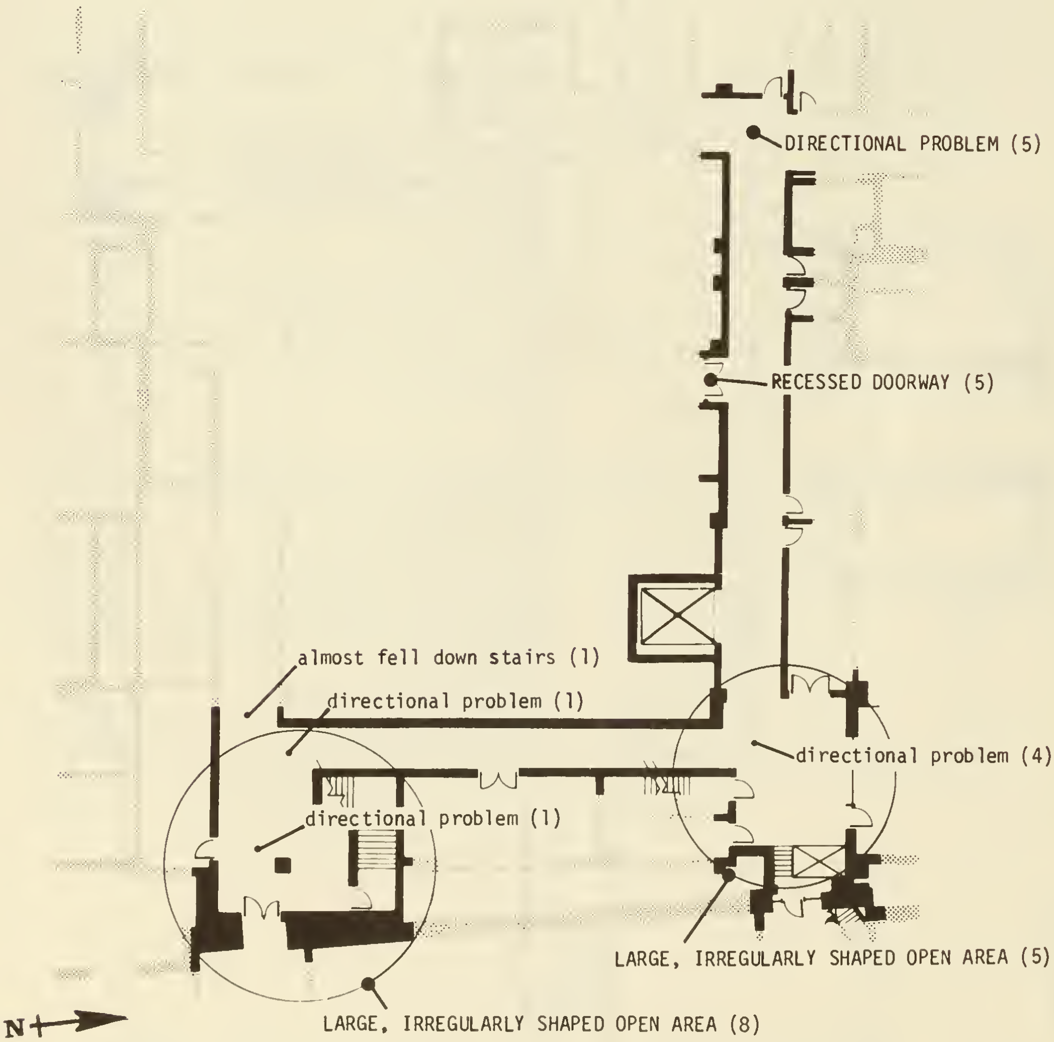
In this appendix the location and description of all directional and environmental problems encountered by the participants during the Phase 1 walk are given by segment. In addition, the number of participants who experienced difficulties at each location are shown in parentheses ( ). The highest total possible is 28. Locations at which five or more persons had problems are shown in upper case lettering.



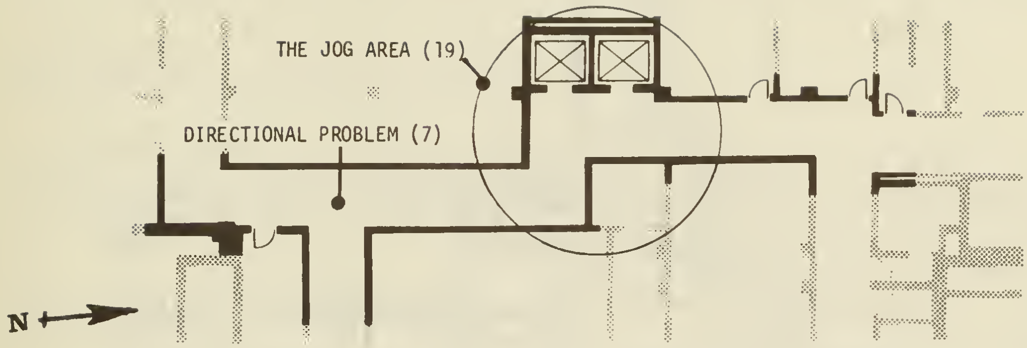

Segment 1a



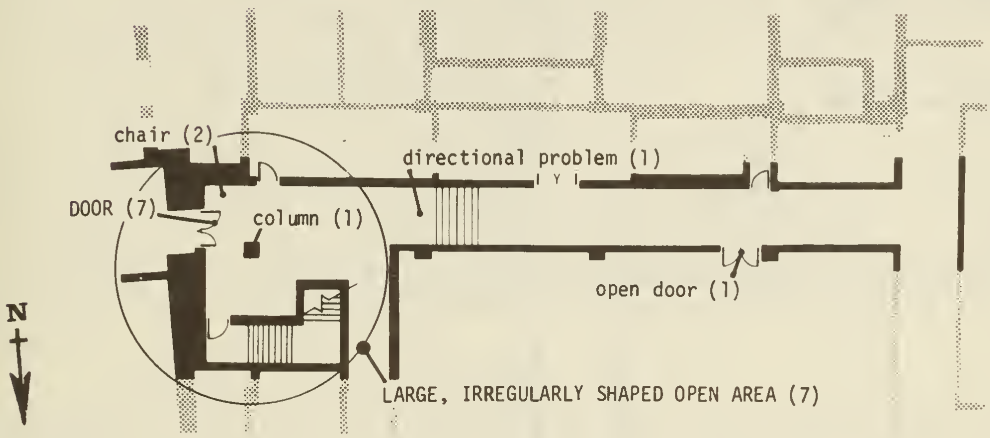

Segment 1b



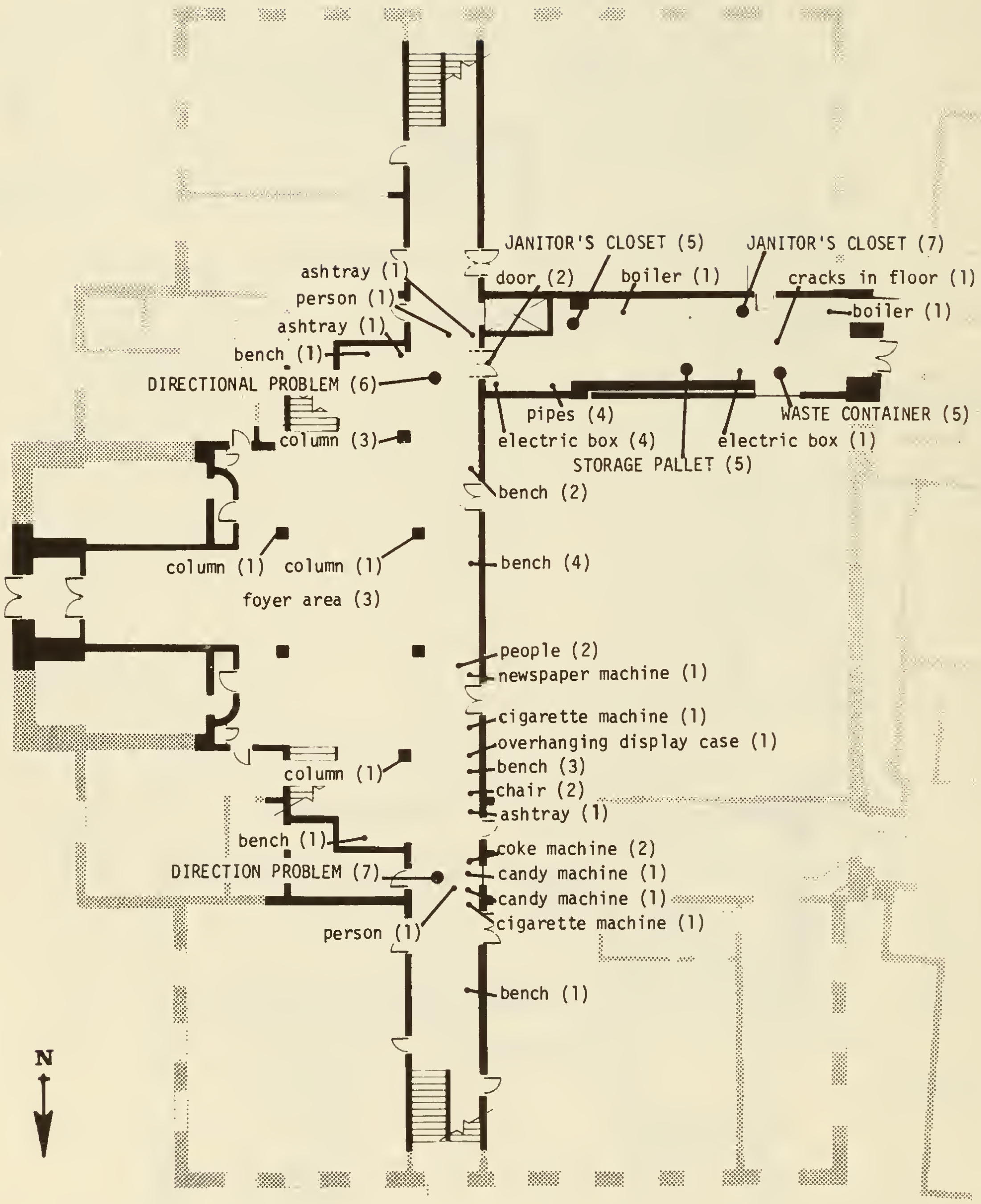

Segment 2




Segment 3




Segment 4

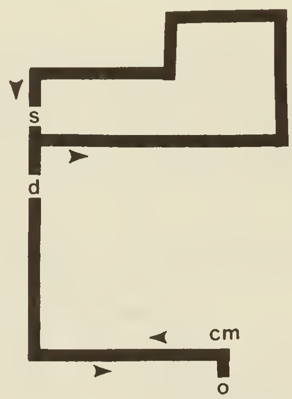

JANITOR'S CLOSET (5)
JANITOR'S CLOSET (7)
ashtray (1)
door (2)
boiler (1)
cracks in floor (1)
person (1)
boiler (1)
ashtray (1)
bench (1)
DIRECTIONAL PROBLEM (6)
pipes (4)
WASTE CONTAINER (5)
column (3)
electric box (4)
electric box (1)
STORAGE PALLET (5)
bench (2)
bench (4)
column (1)
column (1)
foyer area (3)
people (2)
newspaper machine (1)
cigarette machine (1)
overhanging display case (1)
bench (3)
column (1)
chair (2)
ashtray (1)
bench (1)
coke machine (2)
DIRECTION PROBLEM (7)
candy machine (1)
candy machine (1)
person (1)
cigarette machine (1)
bench (1)
N

Segment 5

Appendix D: Discussion of Some of the Maps Constructed During Phase 1

Some of the maps constructed by the study participants during Phase 1 are discussed in this Appendix. These maps were chosen because they exemplify the general types of maps constructed by the Phase 1 participants. In addition, observations made during the walk by the experimentor, and comments made by the participants during the post-walk debriefing are presented. Finally, an analysis of the correlation between the maps and the walk itself is given. Note one notation consistent to all drawings is the direction of travel arrow (➤). All other notations are explained in the text.

Participant 10 (congenital/cane traveler)

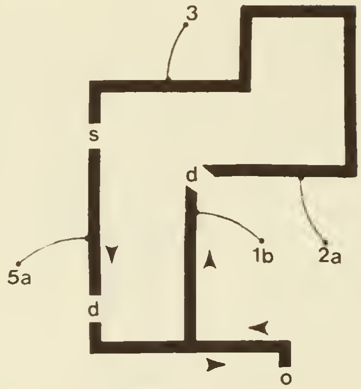



MAP: Participant mapped route correctly (directions and turns are all correct) and attempted to show relative distances. Details shown on the map included the office (o), segment 4 stairway (s), door between Link and Slocum (d), and the Coke machine (cm). Individual had previous tactual mapping experience.

WALK: The individual perceived the route as being easy. There were no major problems. Although difficulties were encountered in trying to find the Slocum-Link passageway in segment 1 and the ramp in segment 2a, the participant did not become disoriented or confused. This person stated that the auditory, tactual, and thermal landmarks encountered in segments 1b and 5a helped in making the connection between the two segments.

ANALYSIS: Previous mapping experience and travel habits helped this individual quite a bit. Since this person did not encounter a large number of obstacles, and did not become disoriented or confused in the more difficult sections of the route, a clearer image of the route was retained. Thus, the map was successfully completed.

Participant 22 (adventitious/cane traveler)

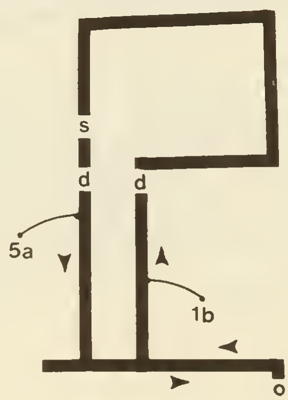



MAP: The route was correctly mapped (directions and turns). An attempt was also made to show relative lengths of segments. The jog was correctly portrayed and the office (o), door (d), and stairway (s) were included. The major mapping error was that segments 1b and 5a were shown as being different passageways (participant also verbally stated this). This person did say, however, that if one proceeded on a straight line from the door at the beginning of 2a, one would reach the segment 3 hallway. Individual had previous mapping experience.

WALK: Individual perceived the route as being easy to negotiate, although minor difficulties were encountered in the jog area (segment 3). This person is an experienced traveler and was very observant during the walk.

ANALYSIS: Travel habits and experience as well as previous mapping experiences aided this traveler. Also, no major difficulties were encountered, and this person did not become confused and was able to use the available cues to form a strong image of the route. Since segments 1b and 5a were not shown as being the same, it seems as if the experience of traveling the Slocum-Link passageway was different depending on the direction of travel (this was investigated further and was shown to be a correct observation).

Participant 3 (adventitious/dog traveler)

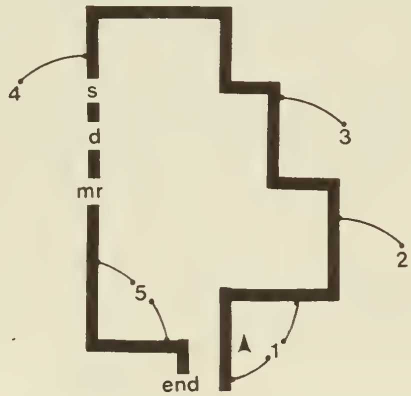


MAP: This participant had some previous mapping experience. Segments 5a and 1b were not equated and the jog was not mapped. The map began and ended at the same point. Details included on the map were the office (o), doors (d), and stairs (s). Also mapped was the extension of the segment 3 corridor in which the participant wandered during the walk.

WALK: The participant stated that the noise in the passageway confused the image of the route. Also, the participant did not perceive the jog as a jog, but as an obstacle which the dog guide avoided. The reason given for missing the turn from segment 3 to segment 4 was that a cross (+) intersection was being searched for and not a T. The route was perceived as easy to negotiate.

ANALYSIS: Since the dog guide led this person through the jog in a relatively straight line of travel (this was true for all dog guide participants), this segment was perceived as a straight line. Again, it is felt that the confusion between 1b and 5a segments was due to the fact that they seem to be different passageways, depending on the direction of travel.

Participant 31 (adventitious/cane traveler)

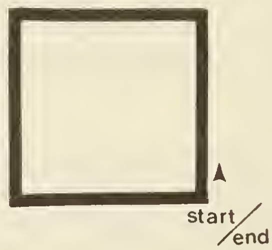



MAP: A circular route was shown, but the map did not begin and end at the same point. No connection was made between segments 1 and 5. Segments 1 and 2 were distorted-- the directions were incorrect. The jog was included and a section of hallway was added between segments 3 and 4. Details shown were the stairs (s), door between Link and Slocum (d), and the machine room or passageway (mr). Individual had previous mapping experience.

WALK: This person perceived the route as being easy to negotiate. During segment 1b the participant encountered a large number of obstacles and needed help to find the Slocum-Link passageway. In segment 2a this person had difficulties in the large area at the top of the ramp. Help was also needed in segment 3. No major difficulties were encountered in segments 4 and 5, although this person wandered a bit in the 5b foyer.

ANALYSIS: There is a correlation between areas distorted on the map (segments 2 and 3, particularly) and areas where major problems were encountered during the walk. This participant did attempt to begin and end at the same place, as evidenced by the extra hallway between segments 3 and 4-- an attempt to make the route circular.

Participant 30 (adventitious/cane traveler)

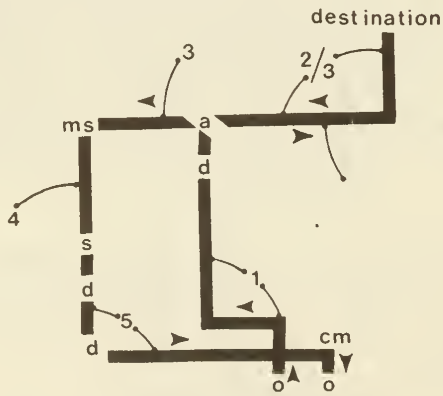



MAP: A circular route was mapped, but no details concerning intersections, landmarks, etc. were included. This individual had mapped previously, but was extremely frustrated by this experience.

WALK: This participant had many problems during the walk, particularly with obstacles in 1a and 5b, and the large irregularly shaped areas in 2a and at the end of 4. This person was extremely confused and frustrated during the walk, and thought it was difficult to negotiate.

ANALYSIS: The confusion and frustration experienced during the walk and the large number of problems encountered helped produce a very poor image of the route. In fact, the only thing retained about the route was that it began and ended at the same point.

Participant 17 (adventitious/cane traveler)



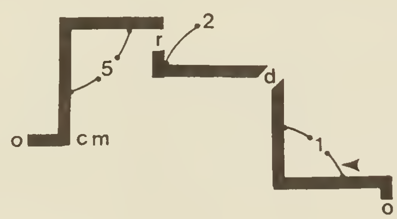

MAP: The map began and ended in the same area. Segments 1, 4 and 5 were mapped correctly and many of the landmarks along the route were detailed:

office (o), doors (d), stairway (s), coke machine (cm), and the metal strip or expansion joint (ms) used to cue the end of segment 3. The large area at the beginning of segment 2a was perceived as an archway. Segment 2 was mapped correctly, but the participant felt that after reaching the destination in Link, segment 2 was traveled in the opposite direction (thus, becoming segment 3). Segments 1 and 5 were not equated. This person had little previous mapping experience.

WALK: This individual had little previous traveling experience outside of the home and immediate neighborhood, and was very nervous during the walk. The participant stated that there was an attempt to concentrate entirely on the directions needed to successfully complete the route. A large number of obstacles were encountered in segments 1 and 5, and aid was needed to find the Slocum-Link passageway. The participant forgot the directions at the end of 1b and had difficulties with the large area at the beginning of 2a. The jog posed a large number of problems and the metal strip cuing the end of segment 3 was missed. Also, the direction leading the traveler from 5a to 5b were forgotten. The participant felt that this was a very difficult route to negotiate.

ANALYSIS: The most difficulty encountered during the walk occurred in segment 3, and this was the area that was most distorted on the map. However, considering the problems encountered during the walk, this participant mapped the course rather well. It is felt that by concentrating so heavily on the directions, a strong enough image of the route was formed to overcome difficulties encountered during the walk. Also, there was a correlation between points where extra help was given and points detailed on the map (e.g. the doorways and the metal strip).

Participant 4 (congenital/cane traveler)



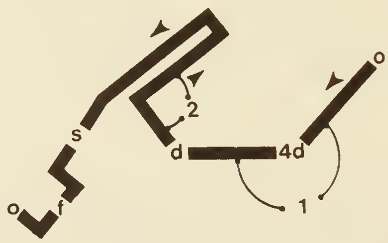

MAP: Segments 1 and 5 were mapped correctly. However, only part of segment 2 was shown, and 3 and 4 were left out completely. The map did not begin or end in the same area. Details shown were the office (o), the door between Slocum and Link (d), the coke machine (cm), and the ramp (r). Participant was very impatient during the post-walk debriefing.

WALK: The participant perceived the route as easy to negotiate. Individual encountered a large number of obstacles in segments 1a and 5

and needed help in finding the Slocum-Link passageway. Participant also had much difficulty in the 2a large area, forgot which direction to turn at the bottom of the ramp and went into the machine shop in segment 2b. Individual had little previous experience mapping.

ANALYSIS: The major factor behind the poor map produced by this participant was impatience, i.e. the participant wanted to finish the exercise as quickly as possible. However, the participant did encounter a large number of problems during segment 2 and the confusion and disorientation caused during this segment may have clouded the image of the route.

Participant 25 (congenital/cane traveler)




MAP: This individual had no previous mapping experience and had tremendous difficulty. Segments 1 and 2 were relatively correct. A number of landmarks were included on the map-- office (o), fourth doorway to Slocum-Link passageway (d), stairs (s), and the foyer (f).

WALK: Participant perceived route as easy to negotiate. Many problems were encountered in 1a and help in finding the passageway was necessary. Individual became extremely confused in the jog.

ANALYSIS: The participant was doing well on the mapping exercise until segment 3 was reached. Following that point, the map became distorted. This correlated with difficulties encountered during the walk. Also, it was apparent to the observer that this individual lacked many of the skills necessary in mapping but which could be developed through proper training.

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